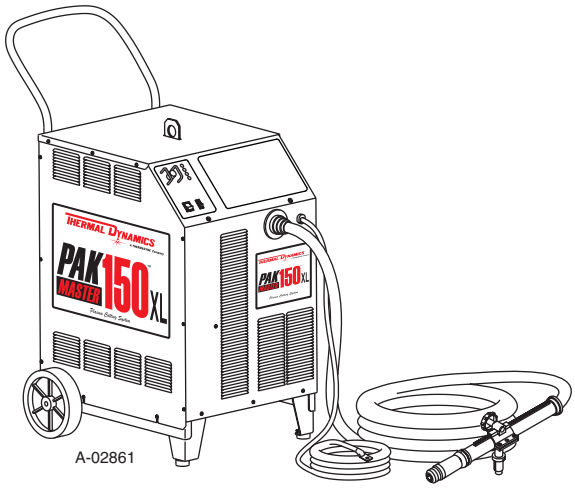
THERMAL DYNAMICS®

A THERMADYNE® Company

Automated Plasma Cutting Power Supply

PAK Master® 150XL™



A-02861

Service Manual

November 18, 2005

Manual No. 0-2825

WARNINGS

Read and understand this entire Manual and your employer's safety practices before installing, operating, or servicing the equipment.

While the information contained in this Manual represents the Manufacturer's best judgement, the Manufacturer assumes no liability for its use.

Automated Plasma Cutting Power Supply
Pak Master® 150XL
Service Manual Number 0-2825

Published by:
Thermal Dynamics Corporation
82 Benning Street
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(603) 298-5711

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Printed in the United States of America

Publication Date: November 18, 2005

Record the following information for Warranty purposes:

Where Purchased:_____

Purchase Date:_____

Power Supply Serial #:_____

Torch Serial #:_____

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SECTION 1: GENERAL INFORMATION

1.01 Notes, Cautions and Warnings

Throughout this manual, notes, cautions, and warnings are used to highlight important information. These highlights are categorized as follows:

NOTE

An operation, procedure, or background information which requires additional emphasis or is helpful in efficient operation of the system.

CAUTION

A procedure which, if not properly followed, may cause damage to the equipment.

WARNING

A procedure which, if not properly followed, may cause injury to the operator or others in the operating area.

1.02 Important Safety Precautions

WARNINGS

OPERATION AND MAINTENANCE OF PLASMA ARC EQUIPMENT CAN BE DANGEROUS AND HAZARDOUS TO YOUR HEALTH.

Plasma arc cutting produces intense electric and magnetic emissions that may interfere with the proper function of cardiac pacemakers, hearing aids, or other electronic health equipment. Persons who work near plasma arc cutting applications should consult their medical health professional and the manufacturer of the health equipment to determine whether a hazard exists.

To prevent possible injury, read, understand and follow all warnings, safety precautions and instructions before using the equipment. Call 1-603-298-5711 or your local distributor if you have any questions.

GASES AND FUMES

Gases and fumes produced during the plasma cutting process can be dangerous and hazardous to your health.

- Keep all fumes and gases from the breathing area. Keep your head out of the welding fume plume.
- Use an air-supplied respirator if ventilation is not adequate to remove all fumes and gases.
- The kinds of fumes and gases from the plasma arc depend on the kind of metal being used, coatings on the metal, and the different processes. You must be very careful when cutting or welding any metals which may contain one or more of the following:

Antimony	Chromium	Mercury
Arsenic	Cobalt	Nickel
Barium	Copper	Selenium
Beryllium	Lead	Silver
Cadmium	Manganese	Vanadium

- Always read the Material Safety Data Sheets (MSDS) that should be supplied with the material you are using. These MSDSs will give you the information regarding the kind and amount of fumes and gases that may be dangerous to your health.
- For information on how to test for fumes and gases in your workplace, refer to item 1 in Subsection 1.03, Publications in this manual.
- Use special equipment, such as water or down draft cutting tables, to capture fumes and gases.
- Do not use the plasma torch in an area where combustible or explosive gases or materials are located.
- Phosgene, a toxic gas, is generated from the vapors of chlorinated solvents and cleansers. Remove all sources of these vapors.
- This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety Code Sec. 25249.5 et seq.)

ELECTRIC SHOCK

Electric Shock can injure or kill. The plasma arc process uses and produces high voltage electrical energy. This electric energy can cause severe or fatal shock to the operator or others in the workplace.

- Never touch any parts that are electrically "live" or "hot."

- Wear dry gloves and clothing. Insulate yourself from the work piece or other parts of the welding circuit.
- Repair or replace all worn or damaged parts.
- Extra care must be taken when the workplace is moist or damp.
- Install and maintain equipment according to NEC code, refer to item 9 in Subsection 1.03, Publications.
- Disconnect power source before performing any service or repairs.
- Read and follow all the instructions in the Operating Manual.

FIRE AND EXPLOSION

Fire and explosion can be caused by hot slag, sparks, or the plasma arc.

- Be sure there is no combustible or flammable material in the workplace. Any material that cannot be removed must be protected.
- Ventilate all flammable or explosive vapors from the workplace.
- Do not cut or weld on containers that may have held combustibles.
- Provide a fire watch when working in an area where fire hazards may exist.
- Hydrogen gas may be formed and trapped under aluminum workpieces when they are cut underwater or while using a water table. **DO NOT** cut aluminum alloys underwater or on a water table unless the hydrogen gas can be eliminated or dissipated. Trapped hydrogen gas that is ignited will cause an explosion.

NOISE

Noise can cause permanent hearing loss. Plasma arc processes can cause noise levels to exceed safe limits. You must protect your ears from loud noise to prevent permanent loss of hearing.

- To protect your hearing from loud noise, wear protective ear plugs and/or ear muffs. Protect others in the workplace.
- Noise levels should be measured to be sure the decibels (sound) do not exceed safe levels.
- For information on how to test for noise, see item 1 in Subsection 1.03, Publications, in this manual.

PLASMA ARC RAYS

Plasma Arc Rays can injure your eyes and burn your skin. The plasma arc process produces very bright ultra violet and infra red light. These arc rays will damage your eyes and burn your skin if you are not properly protected.

- To protect your eyes, always wear a welding helmet or shield. Also always wear safety glasses with side shields, goggles or other protective eye wear.
- Wear welding gloves and suitable clothing to protect your skin from the arc rays and sparks.
- Keep helmet and safety glasses in good condition. Replace lenses when cracked, chipped or dirty.
- Protect others in the work area from the arc rays. Use protective booths, screens or shields.
- Use the shade of lens as suggested in the following per ANSI/ASC Z49.1:

Arc Current	Minimum Protective Shade No.	Suggested Shade No.
Less Than 300*	8	9
300 - 400*	9	12
400 - 800*	10	14

** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the workpiece.*

1.03 Publications

Refer to the following standards or their latest revisions for more information:

1. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
3. NIOSH, SAFETY AND HEALTH IN ARC WELDING AND GAS WELDING AND CUTTING, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018
5. ANSI Standard Z41.1, STANDARD FOR MEN'S SAFETY-TOE FOOTWEAR, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018

6. ANSI Standard Z49.2, FIRE PREVENTION IN THE USE OF CUTTING AND WELDING PROCESSES, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018

7. AWS Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES, obtainable from American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126

8. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING, CUTTING AND ALLIED PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

9. NFPA Standard 70, NATIONAL ELECTRICAL CODE, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

11. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202

12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING, obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3

13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103

14. American Welding Society Standard AWSF4.1, RECOMMENDED SAFE PRACTICES FOR THE PREPARATION FOR WELDING AND CUTTING OF CONTAINERS AND PIPING THAT HAVE HELD HAZARDOUS SUBSTANCES, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126

15. ANSI Standard Z88.2, PRACTICE FOR RESPIRATORY PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018

1.04 Note, Attention et Avertissement

Dans ce manuel, les mots "note," "attention," et "avertissement" sont utilisés pour mettre en relief des informations à caractère important. Ces mises en relief sont classifiées comme suit :

NOTE

Toute opération, procédure ou renseignement général sur lequel il importe d'insister davantage ou qui contribue à l'efficacité de fonctionnement du système.

ATTENTION

Toute procédure pouvant résulter l'endommagement du matériel en cas de non-respect de la procédure en question.

AVERTISSEMENT

Toute procédure pouvant provoquer des blessures de l'opérateur ou des autres personnes se trouvant dans la zone de travail en cas de non-respect de la procédure en question.

1.05 Precautions De Securite Importantes

AVERTISSEMENTS

L'OPÉRATION ET LA MAINTENANCE DU MATÉRIEL DE SOUDAGE À L'ARC AU JET DE PLASMA PEUVENT PRÉSENTER DES RISQUES ET DES DANGERS DE SANTÉ.

Coupant à l'arc au jet de plasma produit de l'énergie électrique haute tension et des émissions magnétique qui peuvent interférer la fonction propre d'un "pacemaker" cardiaque, les appareils auditif, ou autre matériel de santé electronique. Ceux qui travail près d'une application à l'arc au jet de plasma devrait consulter leur membre professionel de médication et le manufacturier de matériel de santé pour déterminer s'il existe des risques de santé.

Il faut communiquer aux opérateurs et au personnel TOUS les dangers possibles. Afin d'éviter les blessures possibles, lisez, comprenez et suivez tous les avertissements, toutes les précautions de sécurité et toutes les consignes avant d'utiliser le matériel. Composez le + 603-298-5711 ou votre distributeur local si vous avez des questions.

FUMÉE et GAZ

La fumée et les gaz produits par le procédé de jet de plasma peuvent présenter des risques et des dangers de santé.

- Eloignez toute fumée et gaz de votre zone de respiration. Gardez votre tête hors de la plume de fumée provenant du chalumeau.
- Utilisez un appareil respiratoire à alimentation en air si l'aération fournie ne permet pas d'éliminer la fumée et les gaz.
- Les sortes de gaz et de fumée provenant de l'arc de plasma dépendent du genre de métal utilisé, des revêtements se trouvant sur le métal et des différents procédés. Vous devez prendre soin lorsque vous coupez ou soudez tout métal pouvant contenir un ou plusieurs des éléments suivants:

antimoine	cadmium mercure	
argent	chrome	nickel
arsenic	cobalt	plomb
baryum	cuivre	sélénium
béryllium	manganèse	vanadium

- Lisez toujours les fiches de données sur la sécurité des matières (sigle américain "MSDS"); celles-ci devraient être fournies avec le matériel que vous utilisez. Les MSDS contiennent des renseignements quant à la quantité et la nature de la fumée et des gaz pouvant poser des dangers de santé.
- Pour des informations sur la manière de tester la fumée et les gaz de votre lieu de travail, consultez l'article 1 et les documents cités à la page 5.
- Utilisez un équipement spécial tel que des tables de coupe à débit d'eau ou à courant descendant pour capter la fumée et les gaz.
- N'utilisez pas le chalumeau au jet de plasma dans une zone où se trouvent des matières ou des gaz combustibles ou explosifs.
- Le phosgène, un gaz toxique, est généré par la fumée provenant des solvants et des produits de nettoyage chlorés. Eliminez toute source de telle fumée.
- Ce produit, dans le procéder de soudage et de coupe, produit de la fumée ou des gaz pouvant contenir des éléments reconnu dans L'état de la Californie, qui peuvent causer des défauts de naissance et le cancer. (La sécurité de santé en Californie et la code sécurité Sec. 25249.5 et seq.)

CHOC ELECTRIQUE

Les chocs électriques peuvent blesser ou même tuer. Le procédé au jet de plasma requiert et produit de l'énergie électrique haute tension. Cette énergie électrique peut produire des chocs graves, voire mortels, pour l'opérateur et les autres personnes sur le lieu de travail.

- Ne touchez jamais une pièce "sous tension" ou "vive"; portez des gants et des vêtements secs. Isolez-vous de la pièce de travail ou des autres parties du circuit de soudage.
- Réparez ou remplacez toute pièce usée ou endommagée.
- Prenez des soins particuliers lorsque la zone de travail est humide ou moite.
- Montez et maintenez le matériel conformément au Code électrique national des Etats-Unis. (Voir la page 5, article 9.)
- Débranchez l'alimentation électrique avant tout travail d'entretien ou de réparation.
- Lisez et respectez toutes les consignes du Manuel de consignes.

INCENDIE ET EXPLOSION

Les incendies et les explosions peuvent résulter des scories chaudes, des étincelles ou de l'arc de plasma. Le procédé à l'arc de plasma produit du métal, des étincelles, des scories chaudes pouvant mettre le feu aux matières combustibles ou provoquer l'explosion de fumées inflammables.

- Soyez certain qu'aucune matière combustible ou inflammable ne se trouve sur le lieu de travail. Protégez toute telle matière qu'il est impossible de retirer de la zone de travail.
- Procurez une bonne aération de toutes les fumées inflammables ou explosives.
- Ne coupez pas et ne soudez pas les conteneurs ayant pu renfermer des matières combustibles.
- Prévoyez une veille d'incendie lors de tout travail dans une zone présentant des dangers d'incendie.
- Le gas hydrogène peut se former ou s'accumuler sous les pièces de travail en aluminium lorsqu'elles sont coupées sous l'eau ou sur une table d'eau. NE PAS couper les alliages en aluminium sous l'eau ou sur une table d'eau à moins que le gas hydrogène peut s'échapper ou se dissiper. Le gas hydrogène accumulé explosera si enflammé.

RAYONS D'ARC DE PLASMA

Les rayons provenant de l'arc de plasma peuvent blesser vos yeux et brûler votre peau. Le procédé à l'arc de plasma produit une lumière infra-rouge et des rayons ultra-violets très forts. Ces rayons d'arc nuiront à vos yeux et brûleront votre peau si vous ne vous protégez pas correctement.

- Pour protéger vos yeux, portez toujours un casque ou un écran de soudeur. Portez toujours des lunettes de sécurité munies de parois latérales ou des lunettes de protection ou une autre sorte de protection oculaire.
- Portez des gants de soudeur et un vêtement protecteur approprié pour protéger votre peau contre les étincelles et les rayons de l'arc.
- Maintenez votre casque et vos lunettes de protection en bon état. Remplacez toute lentille sale ou comportant fissure ou rognure.
- Protégez les autres personnes se trouvant sur la zone de travail contre les rayons de l'arc en fournissant des cabines ou des écrans de protection.
- Utilisez la nuance de lentille qui est suggèrée dans le recommendation qui suivent ANSI/ASC Z49.1:

Courant Arc	Nuance Minimum Protective Numéro	Nuance Suggerée Numéro
Moins de 300*	8	9
300 - 400*	9	12
400 - 800*	10	14

** Ces valeurs s'appliquent ou l'arc actuel est observé clairement. L'experience a démontrer que les filtres moins foncés peuvent être utilisés quand l'arc est caché par moiceau de travail.*

BRUIT

Le bruit peut provoquer une perte permanente de l'ouïe. Les procédés de soudage à l'arc de plasma peuvent provoquer des niveaux sonores supérieurs aux limites normalement acceptables. Vous dú4ez vous protéger les oreilles contre les bruits forts afin d'éviter une perte permanente de l'ouïe.

- Pour protéger votre ouïe contre les bruits forts, portez des tampons protecteurs et/ou des protections auriculaires. Protégez également les autres personnes se trouvant sur le lieu de travail.
- Il faut mesurer les niveaux sonores afin d'assurer que les décibels (le bruit) ne dépassent pas les niveaux sûrs.
- Pour des renseignements sur la manière de tester le bruit, consultez l'article 1, page 5.

1.06 Documents De Reference

Consultez les normes suivantes ou les révisions les plus récentes ayant été faites à celles-ci pour de plus amples renseignements :

1. OSHA, NORMES DE SÉCURITÉ DU TRAVAIL ET DE PROTECTION DE LA SANTÉ, 29CFR 1910, disponible auprès du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. Norme ANSI Z49.1, LA SÉCURITÉ DES OPÉRATIONS DE COUPE ET DE SOUDAGE, disponible auprès de la Société Américaine de Soudage (American Welding Society), 550 N.W. LeJeune Rd., Miami, FL 33126
3. NIOSH, LA SÉCURITÉ ET LA SANTÉ LORS DES OPÉRATIONS DE COUPE ET DE SOUDAGE À L'ARC ET AU GAZ, disponible auprès du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
4. Norme ANSI Z87.1, PRATIQUES SURES POUR LA PROTECTION DES YEUX ET DU VISAGE AU TRAVAIL ET DANS LES ECOLES, disponible de l'Institut Américain des Normes Nationales (American National Standards Institute), 1430 Broadway, New York, NY 10018
5. Norme ANSI Z41.1, NORMES POUR LES CHAUSSURES PROTECTRICES, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018
6. Norme ANSI Z49.2, PRÉVENTION DES INCENDIES LORS DE L'EMPLOI DE PROCÉDÉS DE COUPE ET DE SOUDAGE, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018
7. Norme A6.0 de l'Association Américaine du Soudage (AWS), LE SOUDAGE ET LA COUPE DE CONTENEURS AYANT RENFERMÉ DES PRODUITS COMBUSTIBLES, disponible auprès de la American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126
8. Norme 51 de l'Association Américaine pour la Protection contre les Incendies (NFPA), LES SYSTEMES À GAZ AVEC ALIMENTATION EN OXYGENE POUR LE SOUDAGE, LA COUPE ET LES PROCÉDÉS ASSOCIÉS, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
9. Norme 70 de la NFPA, CODE ELECTRIQUE NATIONAL, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

10. Norme 51B de la NFPA, LES PROCÉDÉS DE COUPE ET DE SOUDAGE, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

11. Brochure GCAP-1, LA MANIPULATION SANS RISQUE DES GAZ COMPRIMÉS EN CYLINDRES, disponible auprès de l'Association des Gaz Comprimés (Compressed Gas Association), 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202

12. Norme CSA W117.2, CODE DE SÉCURITÉ POUR LE SOUDAGE ET LA COUPE, disponible auprès de l'Association des Normes Canadiennes, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada, M9W 1R3

13. Livret NWSA, BIBLIOGRAPHIE SUR LA SÉCURITÉ DU SOUDAGE, disponible auprès de l'Association Nationale de Fournitures de Soudage (National Welding Supply Association), 1900 Arch Street, Philadelphia, PA 19103

14. Norme AWSF4.1 de l'Association Américaine de Soudage, RECOMMANDATIONS DE PRATIQUES SURES POUR LA PRÉPARATION À LA COUPE ET AU SOUDAGE DE CONTENEURS ET TUYAUX AYANT RENFERMÉ DES PRODUITS DANGEREUX , disponible auprès de la American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126

15. Norme ANSI Z88.2, PRATIQUES DE PROTECTION RESPIRATOIRE, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018

1.07 Declaration of Conformity

Manufacturer: Thermal Dynamics Corporation
Address: 82 Benning Street
West Lebanon, New Hampshire 03784
USA

The equipment described in this manual conforms to all applicable aspects and regulations of the 'Low Voltage Directive' (European Council Directive 73/23/EEC as amended by Council Directive 93/68/EEC) and to the National legislation for the enforcement of this Directive.

The equipment described in this manual conforms to all applicable aspects and regulations of the "EMC Directive" (European Council Directive 89/336/EEC) and to the National legislation for the enforcement of this Directive.

Serial numbers are unique with each individual piece of equipment and details description, parts used to manufacture a unit and date of manufacture.

National Standard and Technical Specifications

The product is designed and manufactured to a number of standards and technical requirements. Among them are:

* CSA (Canadian Standards Association) standard C22.2 number 60 for Arc welding equipment.

* UL (Underwriters Laboratory) rating 94VO flammability testing for all printed-circuit boards used.

* ISO/IEC 60974-1 (BS 638-PT10) (EN 60 974-1) (EN50192) (EN50078) applicable to plasma cutting equipment and associated accessories.

* CENELEC EN50199 EMC Product Standard for Arc Welding Equipment

* For environments with increased hazard of electrical shock, Power Supplies bearing the S mark conform to EN50192 when used in conjunction with hand torches with exposed tips, if equipped with properly installed stand-off guides.

* Extensive product design verification is conducted at the manufacturing facility as part of the routine design and manufacturing process. This is to ensure the product is safe, when used according to instructions in this manual and related industry standards, and performs as specified. Rigorous testing is incorporated into the manufacturing process to ensure the manufactured product meets or exceeds all design specifications.

Thermal Dynamics has been manufacturing products for more than 30 years, and will continue to achieve excellence in our area of manufacture.

Manufacturers responsible representative: Steve Ward
Operations Director
Thermadyne Europe
Europa Building
Chorley N Industrial Park
Chorley, Lancashire,
England PR6 7BX

CE

1.08 Statement of Warranty

LIMITED WARRANTY: Thermal Dynamics® Corporation (hereinafter "Thermal") warrants that its products will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within the time period applicable to the Thermal products as stated below, Thermal shall, upon notification thereof and substantiation that the product has been stored, installed, operated, and maintained in accordance with Thermal's specifications, instructions, recommendations and recognized standard industry practice, and not subject to misuse, repair, neglect, alteration, or accident, correct such defects by suitable repair or replacement, at Thermal's sole option, of any components or parts of the product determined by Thermal to be defective.

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

LIMITATION OF LIABILITY: Thermal shall not under any circumstances be liable for special or consequential damages, such as, but not limited to, damage or loss of purchased or replacement goods, or claims of customers of distributor (hereinafter "Purchaser") for service interruption. The remedies of the Purchaser set forth herein are exclusive and the liability of Thermal with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, or use of any goods covered by or furnished by Thermal whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liability is based.

THIS WARRANTY BECOMES INVALID IF REPLACEMENT PARTS OR ACCESSORIES ARE USED WHICH MAY IMPAIR THE SAFETY OR PERFORMANCE OF ANY THERMAL PRODUCT.

THIS WARRANTY IS INVALID IF THE PRODUCT IS SOLD BY NON-AUTHORIZED PERSONS.

The limited warranty periods for Thermal products shall be as follows (with the exception of XL Plus Series, CutMaster Series , Cougar and DRAG-GUN): A maximum of three (3) years from date of sale to an authorized distributor and a maximum of two (2) years from date of sale by such distributor to the Purchaser, and with the further limitations on such two (2) year period (see chart below).

The limited warranty period for XL Plus Series and CutMaster Series shall be as follows: A maximum of four (4) years from date of sale to an authorized distributor and a maximum of three (3) years from date of sale by such distributor to the Purchaser, and with the further limitations on such three (3) year period (see chart below).

The limited warranty period for Cougar and DRAG-GUN shall be as follows: A maximum of two (2) years from date of sale to an authorized distributor and a maximum of one (1) year from date of sale by such distributor to the Purchaser, and with the further limitations on such two (2) year period (see chart below).

	Parts			
PAK Units, Power Supplies	**XL Plus & CutMaster Series**	**Parts Cougar/Drag-Gun**	**Parts All Others**	**Labor**
Main Power Magnetics	3 Years	1 Year	2 Years	1 Year
Original Main Power Rectifier	3 Years	1 Year	2 Years	1 Year
Control PC Board	3 Years	1 Year	2 Years	1 Year
All Other Circuits And Components Including, But Not Limited To, Starting Circuit, Contactors, Relays, Solenoids, Pumps, Power Switching Semi-Conductors	1 Year	1 Year	1 Year	1 Year
Consoles, Control Equipment, Heat Exchanges, And Accessory Equipment	1 Year		1 Year	1 Year
Torch And Leads				
Maximizer 300 Torch			1 Year	1 Year
SureLok Torches	1 Year		1 Year	1 Year
All Other Torches	180 Days	180 Days	180 Days	180 Days
Repair/Replacement Parts	90 Days	90 Days	90 Days	None

Warranty repairs or replacement claims under this limited warranty must be submitted by an authorized Thermal Dynamics® repair facility within thirty (30) days of the repair. No transportation costs of any kind will be paid under this warranty. Transportation charges to send products to an authorized warranty repair facility shall be the responsibility of the customer. All returned goods shall be at the customer's risk and expense. This warranty supersedes all previous Thermal warranties.

Effective: November 15, 2001

SECTION 2: INTRODUCTION

2.01 Scope Of Manual

This Manual provides Service Instructions for Thermal Dynamics PAK Master® 150XL Automated Plasma Power Supply.

Refer to Operating Manual (0-2824) for individual operating procedures. Information in this edition is therefore particularly applicable to the Troubleshooting and Repair of the equipment, and is intended for use by properly trained Service Technicians familiar with this equipment.

Read this manual and the Operating Manual thoroughly. A complete understanding of the capabilities and functions of the equipment will assure obtaining the performance for which it was designed.

2.02 General Service Philosophy

Several key points are essential to properly support the application and operation of this equipment.

A. Application

The equipment should satisfy the customer's requirements as supplied and as described in Section 3 of this manual. Be sure to confirm that the equipment is capable of the application desired.

B. Modifications

No physical or electrical modifications other than selection of standard options and accessories are to be made to this equipment.

C. Customer/Operator Responsibilities

It is the customer/operator's responsibility to maintain the equipment and peripheral accessories provided by Thermal Dynamics in good operating order in accordance with the procedures outlined in the Operating Manual, and to protect the equipment from accidental or malicious damage.

D. Repair Restrictions

The electronics consists of Printed Circuit Board Assemblies which must be carefully handled, and must be replaced as units. No replacement of printed circuit solder-mounted components is allowed except as noted in this manual.

Printed Circuit Board Assemblies to be returned must be properly packaged in protective material and returned intact per normal procedures.

2.03 Service Responsibilities

The Service Technician should be familiar with the equipment and its capabilities and should be prepared to recommend arrangements of components which will provide the most efficient layout, utilizing the equipment to its best possible advantage.

Maintenance work should be accomplished in a timely manner. If problems are encountered, or the equipment does not function as specified, contact Technical Services Department at West Lebanon for assistance.

SECTION 3: DESCRIPTION

3.01 Scope of Manual

The information in this section has two purposes:

- To familiarize the service technician with the capabilities and limitations of the equipment,
- To provide an overall understanding which will allow the technician, in turn, to properly train customer's operating personnel.

3.02 Power Supply General Description

Power Supply is designed to cut most metals up to 1-1/2 inches (38 mm) using air, nitrogen, or argon/hydrogen as the plasma gas. This system is also capable of satisfying many mechanized gouging applications.

The Automated Power Supply provides 120 amp maximum output current and includes all control circuitry, electrical and gas inputs and outputs, pilot circuitry, torch leads receptacle and a 20 ft (6.1 m) work cable with ring lug.

The torch used with the Power Supply is available in the following configuration:

- 180° Machine Torch Head (PCM) with 1-3/8 inch (34 mm) diameter Mounting Tube with Rack and Pinion Assembly

Automated system include a machine torch with shielded leads and a CNC Interface Cable.

NOTES

The power supply can be ordered in various configurations with various options factory installed.

Refer to the supplied Torch Instruction Manual for more information on the Torch.

Refer to Section 3.04 for list of Power Supply Options and Accessories.

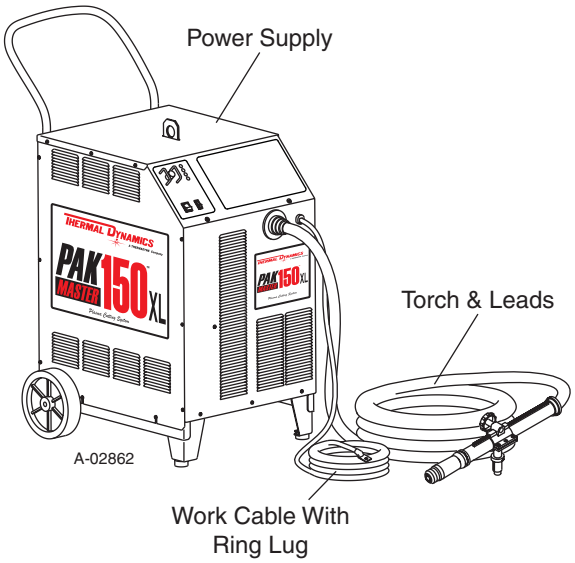


Figure 3-1 Automated Pak Master 150XL System

The Extra-Cool™ Coolant supplied with the Power Supply can be used in ambient temperatures down to 10° F (-12° C). For lower temperatures, Ultra-Cool™ Coolant should be used. This coolant can be used in areas where the ambient temperature drops to -27° F (-33° C).

A. Typical System

A typical system configuration will contain the following:

- Automated Power Supply
- 20 ft (6.1 m) Work Cable with Ring Lug
- PCM Torch with 25 ft (7.6 m) or 50 ft (15.2 m) Leads length as ordered
- PCM Torch Spare Parts Kit
- CNC Interface Cable, 25 ft (7.6 m) or 50 ft (15.2 m) length as ordered
- Standard Thermal Arc Coolant - 3 gallons (11.4 liters)

NOTE

Refer to Section 3.04 for complete list of Power Supply Options and Accessories.

B. Requirements to Complete System

To complete the system, the user needs to provide the following:

- Primary Input Power Cable
- Gas Supplies

3.03 Specifications/Design Features

A. Power Supply Specifications

The following specifications apply to the Power Supply only:

1. **Front Panel Controls**
   - ON/OFF and RUN/SET Switches
   - Output Current Control
   - Work Cable Connection
   - Torch Leads Connection
2. **Front Panel LED Indicators**
   - AC
   - TEMP
   - GAS Pressure/Coolant Flow
   - DC Output
3. **Rear Panel**
   - Primary Input Power Cable Strain Relief
   - Plasma Gas Supply Connection
   - Plasma Gas Regulator/Filter Assembly with Gas Pressure Gauge and Pressure Adjustment
   - Secondary Gas Supply Connection
   - Secondary Gas Regulator/Filter Assembly with Gas Pressure Gauge and Pressure Adjustment
   - Two Stage Air Line Filter
   - CNC Control Connector
4. **Input Power (see NOTES)**

   208/230/460 VAC (±10%), 50/60 Hz, Three-Phase

   220/380-415 VAC (±10%), 50/60 Hz, Three-Phase

   575 VAC (±10%), 50/60Hz, Three-Phase

   NOTES

   Refer to Appendix 1 for suggested input wiring size, current ratings and circuit protection requirements.

   Units using 575 VAC input power require installation of Optional 575V Transformer Assembly.

5. **Output Power**

   Continuously variable from 30 to 120 amps (±5%)

6. **Duty Cycle**

   60% @ 128 vdc output at 120 amps

7. **Cut Capacity on Carbon Steel**
   - Genuine Cut Capacity: 1-1/2 inch (38 mm)
   - Severance Cut: 1- 3/4 inch (44 mm)
   - Pierce Rating: 5/8 inch (15.9 mm)
8. **Pilot Circuitry**

   Capacitive Discharge (CD), Pulsed DC

9. **CNC Interface Signals**

   Start/Stop, OK-To-Move and Arc Voltage

10. **Coolant Pressure**

    Internal Service Adjustable (Factory Only)

    130 psi (8.8 bar) at zero flow

    120 - 125 psi (8.2 - 8.5 bar) at 0.6 gpm (2.3 lpm)

11. **Coolant Flow Rate**

    0.5 gpm (1.9 lpm) with 150 feet (45.7 m) of total torch and torch leads at 70°F (21°C)

    NOTE

    The flow rate varies with lead length, torch configuration, ambient temperature, amperage level, etc.

12. **Cooling Capacity**

    4,000 to 10,000 BTU

    NOTE

    Maximum value based on "free flow" condition.

13. **Coolant Reservoir Capacity**

    2 gallons (Use Thermal Arc® coolant only)

    Capable of handling a total of 150 feet (45.7 m) of torch lead length

14. **Overall Dimensions**

    Height: 45-3/8 inches (1.2 m)

    Width: 24-1/2 in (0.6 m)

    Depth: 35 inches (0.9 m)

15. **Weight**

    Power Supply with Torch: 275 lbs (125 kg)

    Shipping Weight: 350 lbs (158.8 kg)

16. **Used With Torch**
    - PCM-120 Automated Machine Torch

B. Gas Regulator/Filter Assembly Specifications

The following specifications apply to the Gas Regulator/Filter Assembly only:

1. **Gas Regulator Maximum Gauge Pressure**

   Plasma: 160 psi (11.3 bar)

   Secondary: 160 psi (11.3 bar)

2. **Maximum Input Gas Pressure**

   125 psi (8.6 bar)

3. **Filter**

   Coalescent type filter

C. Gas Requirements

1. **Plasma**

   Gases: Compressed Air, Nitrogen, Argon/Hydrogen

   Operating Pressure: 65 psi (4.5 bar)

   Cold Flow:

   Cutting: 50 - 78 scfh (23.6 - 36.8 lpm)

   Gouging: 85 - 95 scfh (40.1 - 44.8 lpm)

   CAUTION

   Maximum input gas pressure must not exceed 125 psi (8.6 bar).

2. **Secondary**

   Gases: Compressed Air, Carbon Dioxide ($C0_2$), Nitrogen

   Operating Pressure: 60 psi (4.1 bar)

   Cold Flow:

   Cutting: 340 scfh (160.4 lpm)

   Gouging: 235 scfh (110.9 lpm)

   CAUTION

   Maximum input gas pressure must not exceed 125 psi (8.6 bar).

D. Two Stage Air Line Filter

The Two Stage Air Line Filter will remove moisture and contaminants from the air stream when using compressed air. The filter is capable of filtering to at least 5 microns.

3.04 Power Supply Options and Accessories

The following accessories are available for the Power Supply. Refer to Section 6, Parts Lists, for part numbers and ordering information.

A. Primary Input Power Cable

The following input power cables are available:

- 230VAC, (2AWG) 10 ft (3 m)
- 460VAC, (6AWG) 10 ft (3 m)

B. High Pressure Regulators

High pressure regulators are available for air, nitrogen, and argon-hydrogen. The regulators are used to set the proper pressure for the type of gas being used.

C. 575V Transformer

This 575 VAC to 460 VAC Step-down Transformer allows the Power Supply to operate on 575 VAC three-phase input power.

D. Standoff Control (SC11)

Optional Standoff Control automatically finds height and maintains torch standoff with a high speed torch lifter motor. Refer to Standoff Control (SC11) Manual, 0-2556, for more information.

E. Remote Pendant Control

Control used to manually start and stop cutting operations from a location up to 20 ft. (6.1 m) from the Plasma Power Supply.

2.05 Theory Of Operation

A. Plasma Arc Cutting and Gouging

Plasma is a gas which is heated to an extremely high temperature and ionized so that it becomes electrically conductive. The plasma arc cutting process uses this plasma gas to transfer an electric arc to a workpiece. The metal to be cut is melted by the intense heat of the arc and then blown away by the flow of gas.

With a simple change of torch parts, the system can also be used for plasma arc gouging. Plasma arc gouging uses the same process to remove material to a controlled depth and width.

B. Input and Output Power

The unit converts AC input power to DC power for the main cutting arc. The negative output is connected to the torch electrode through the negative torch lead, and the positive output connects to the workpiece through the work cable.

C. Pilot Arc

When the torch is activated there is a 2 second (service adjustable) gas pre-flow, followed by an uninterrupted pulsed DC pilot arc established between the electrode and tip. The pilot arc is initiated by a momentary high frequency pulse from the Power Supply. The pilot creates a path for the main arc to transfer to the work. When the main arc is established, the pilot arc shuts off. The pilot automatically restarts when the main arc stops, as long as the torch remains activated.

D. Main Cutting Arc

The power supply converts the AC input power to DC power for the main cutting arc. The negative output is connected to the torch electrode through the negative torch lead. The positive output is connected to the workpiece via the work cable and clamp connection.

E. RF Shielding

Automated systems using CNC Interface Cables are shielded to minimize radio frequency (RF) interference which results from the high frequency arc initiation. These shielded systems are designed with features such as a wire for establishing an earth ground and shielded torch and control leads. The CNC control signals are filtered on an internal PC Board.

F. Interlocks

The system has several built-in interlocks to provide safe and efficient operation. When an interlock shuts down the system, the fault condition must be remedied and the system recycled using the applicable control device.

1. Parts-In-Place (PIP) Interlock

The Power Supply has a built-in parts-in-place interlock that prevents accidental torch starting when torch parts are not properly installed. A flow switch on the coolant return lead detects reduced coolant flow caused by improper torch assembly. If not satisfied, the switch interrupts power to the tip and electrode.

2. Gas Pressure Interlock

A pressure switch acts as an interlock for the plasma gas supply. If the plasma gas supply pressure falls below minimum requirements the pressure switch will open, shutting off the power to the contactors, and the GAS indicator will go out. When adequate plasma supply pressure is available the pressure switch will close, allowing power to be resumed for cutting.

NOTE

There is no gas pressure interlock for secondary gas.

SECTION 4: SERVICE

4.01 Introduction

This Section provides service diagnostics for the Automated Pak Master 150XL Power Supply, allowing the Technician to isolate any faulty subassemblies. Refer to Section 5, Repairs & Replacement Procedures, for parts replacement instructions.

Under no circumstances are field repairs to be attempted on Printed Circuit Boards or other subassemblies of this unit. Evidence of unauthorized repairs will void the factory warranty.

NOTE

The troubleshooting contained in this manual is for the Power Supply only. Troubleshooting other parts of the system is covered in the separate manuals for that product.

4.02 Periodic Inspection & Procedures

NOTE

Refer to Appendix 13 for a recommended maintenance schedule for water cooled plasma cutting systems.

This subsection describes inspection procedures which should be performed at periodic intervals as required.

A. Physical Inspection

Check that all cable connections are secure.

B. Fan Motor and Pump Lubrication

The fan motor and pump in the power supply should be oiled twice per year or once for each 100 hours of operation. To oil the motor, remove one side panel and add two or three drops of 20 SAE oil to the front and rear oil holes on the motor.

NOTE

Some units may utilize a sealed motor design which does not require lubrication.

C. Power Supply Cleaning

To clean the unit, open the enclosure and use a vacuum cleaner to remove any accumulated dirt and dust. The unit should also be wiped clean. If necessary, solvents that are recommended for cleaning electrical apparatus may be used.

WARNING

*Do NOT blow air **into** the power supply during cleaning; make sure to always blow air **out** of the unit. Blowing air into the unit can cause metal particles to interfere with sensitive electrical components and cause damage to the unit.*

While the side panels are off, inspect the wiring in the unit. Look for any frayed wires or loose connections that should be corrected.

D. Coolant Filter Assembly

The Coolant Filter Screen should be cleaned periodically. To gain access to the Coolant Filter Assembly, remove the right side panel when viewed from front of unit. Remove the Filter Screen by unscrewing the filter holder from the Coolant Filter Assembly. Clean the filter screen by rinsing with hot soapy water. Remove soap residue by rinsing with clean hot water. Be sure that all the soap has been removed and the screen is dry of water before reinstalling in the Coolant Filter Assembly.

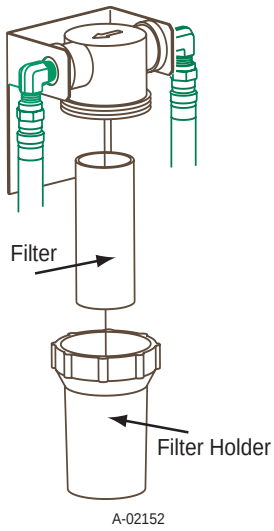


Figure 5-1 Coolant Filter Assembly

E. In-Line Coolant Filter Assembly

The In-line Coolant Filter Screen should be cleaned periodically. To gain access to the In-Line Coolant Filter Assembly remove the right side panel (when viewed from the front of unit). Remove the Filter Screen by unscrewing the Filter Holder from the In-Line Coolant Filter Assembly. Clean the Filter Screen by rinsing with hot soapy water. Remove soap residue by rinsing with clean hot water. Be sure that all the soap has been removed and the screen is dry of water before reinstalling in the In-Line Coolant Filter Assembly.

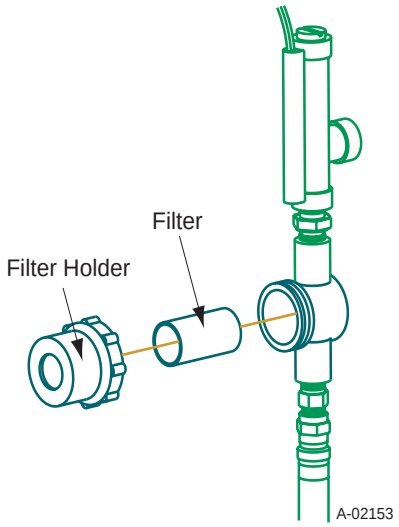


Figure 5-2 In-Line Coolant Filter Assembly

F. Coolant Level and Conductivity

1. Coolant Level

The coolant level should be checked every day at the rear panel coolant gauge. If the coolant in the reservoir is more than 2 inches (50 mm) from the top of the reservoir then add Torch Coolant.

2. Coolant Conductivity

The coolant conductivity level should be checked if the pilot doesn't start.

Check the condition of the deionizer bag in the reservoir basket, if the bag is yellowish brown (straw color) replace the bag and coolant (see NOTE).

NOTE

To accurately measure the coolant conductivity it is recommended to use a Conductivity Sensor similar to Thermal Dynamics Model TDS-73 (Catalog # 7-2844).

G. Draining and Replacing Coolant

Remove the old coolant from the Power Supply reservoir as follows:

1. Remove the right side panel from the Power Supply.
2. Disconnect the coolant input hose to the Coolant Filter Assembly.
3. Carefully lower the hose out the right side of the Power Supply and drain the coolant into an acceptable container.

CAUTION

Handle and dispose of the used coolant per recommended procedures.

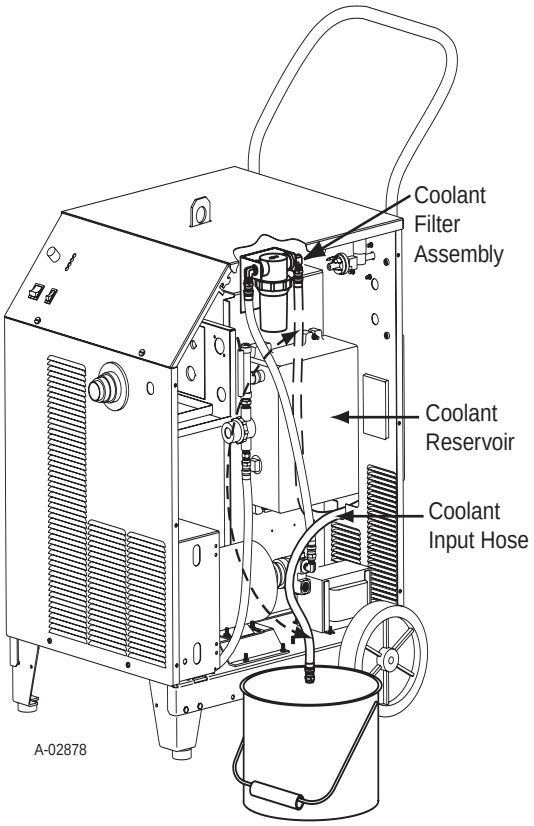


Figure 5-3 Draining Coolant From Reservoir

4. Reconnect the hose to the Coolant Filter Assembly.
5. Remove Coolant Reservoir lid and install new coolant and deionizer bag.
6. Reinstall the right side panel.

4.03 System Theory

The system is designed for mechanized (automated) cutting operations using the torch control bulkhead and rear panel as the interface.

A. Logic PC Board Functions

NOTE

Refer to Appendix 4 for Logic PC Board layout.

The Logic PC Board controls the timing and sequencing of the system. It monitors the pressure, temperature, and flow interlocks and controls the gas flow in run and set modes by turning on the plasma and secondary solenoids. The Logic PC Board also controls the power on the voltage selection and prepurge functions.

After the ON / OFF switch is closed on the front panel, the AC Indicator blinks and the GAS Indicator is ON steady. The AC Indicator blinks for approximately 8 seconds then at that time it becomes steady and the inrush relay closes. The GAS Indicator stays ON for approximately 20 seconds (prepurge function) then goes OFF and the gas stops flowing.

The START signal is activated by one of the following methods:

- Connecting J22-3 to J22-4 at the rear panel CNC connector

  - or -

- Connecting TB-1 pin 3 to TB-1 pin 4 on the Filter / Voltage Divider PC Board

When the START signal is activated, D26 "start" Indicator comes ON, gas will flow for approximately 2 seconds before DC is established (indicated on the front panel). During this time D25 CD Enable will come ON and sends a logic signal to the CD Board which fires the spark gap and initiates the torch to pilot. D25 should go OFF immediately if the pilot starts immediately.

When the torch is close to the workpiece, the cutting arc "transfers" to the work. Also, if the tip touches the workpiece, the current is automatically folded back to approximately 35 amps to save the tip from being blown out.

The resulting current is sensed by the Current Sense PC Board, resulting in the demand level changing from pilot current to whatever the main current control is set at. During the "transfer" the CSR Indicator (D65) comes ON and the transfer enable signal goes low allowing the bottom gate drive and FET modules to come up and start running. Also at this time, D5 (located on the Pilot Output PC Board) shuts off and at this time the main cutting arc is initiated. If the torch is removed from the workpiece, the pilot arc will automatically restart if the START signal is still active.

Logic PC Board	
Indicator	Meaning
D26	START Signal Enable - When ON (start) indicates START signal is active.
D25	CD Enable - Initiates spark gap on CD PC Board. Indicator should come ON then go OFF after a pilot arc has been established.
D65	CSR - Indicates main cutting arc is established.
D47	AC OK - When ON indicates that AC Input voltage is okay.
D31	Drag - When ON indicates that the torch tip is making contact with the workpiece.

B. CD (Capacitive Discharge) PC Board Functions

NOTE

Refer to Appendix 7 for CD PC Board layout.

The CD Board functions are initiated by the CD Enable signal from the Logic PC Board. The CD arc starting circuit fires the spark gap producing the high voltage spark which starts the DC pilot arc. When a pilot arc is sensed by the Gate Drive Board, the PSR signal shuts off the CD enable.

C. Gate Drive PC Board Functions

NOTE

Refer to Appendix 5 for Gate Drive PC Board layout.

This board controls the amount of time the FETs are turned on. This is done with a pulse width modulator (PWM) controlled by the demand signal from the Logic PC Board (The longer the FETs are on, the more output current). If a short develops, the primary overcurrent will shut down the gate drive and not allow the power supply to power up and run.

The PSR signal senses any current in the secondary and determines what the PWM should do for a pulse width. If there is current in the secondary, the PSR signal will go back to the Logic PC Board and shut off the CD Enable signal.

Gate Drive PC Boards	
Indicator	Meaning
D4	Power Enable - When ON PWM Enable received from the Logic PC Board.
D20	Reset - Normally ON, goes out when torch switch is pressed. Indicator will blink if primary overcurrent is detected when torch switch is pressed.

D. Pilot/Output PC Board Functions

NOTE

Refer to Appendix 6 for Pilot/Output PC Board layout.

This board has an IGBT which is turned on by the Logic Board for piloting. This allows the DC to flow from the output (-) through the pilot return (tip) to a Pilot Inductor and finally to the work. This path is broken very quickly by the IGBT when the main cutting arc is initiated. This board also filters the torch shield back to the torch (-) through the Capacitor.

Pilot PC Board	
Indicator	Meaning
D5	IGBT is turned on from the logic signal coming from the Logic Board PCR J5-6. NOTE: This LED is on during piloting; it is off during cutting.

E. Current Sense PC Board Functions

NOTE

Refer to Appendix 11 for Current Sense PC Board layout.

This board senses current in the work lead (approximately 3 amps). When this happens, it sends a signal back to the Logic Board. This in turn tells the Logic to change demand levels from pilot current to main cutting current.

F. Filter/Voltage Divider PC Board Functions

NOTE

Refer to Appendix 18 for Filter/Voltage Divider PC Board Diagram.

The Filter / Voltage Divider PC Board provides common mode inductors for all the Remote (J22) CNC signals that require filtering. These inductors, in series with the control signals, work with the capacitance between the control signal lines of the CNC (remote control) cable and the cable shield to form an LC (inductive / capacitive) lowpass filter. To obtain the required capacitance for the lowpass filter to work, the CNC cable shield must be terminated to ground (grounded chassis) at the cutting machine end of the cable.

The Filter / Voltage Divider PC Board also contains the voltage divider circuit for the SC11 Standoff Control. The voltage divider converts and filters the high negative arc voltage to a lower positive signal used by the SC-11 Standoff Control. Arc voltage plus (+) and minus (-) with 100K ohm series resistors are also provided for use by certain other standoff controls.

4.04 Common Operating Problems

WARNINGS

Disconnect primary power at the source before disassembling the power supply, torch, or torch leads.

Frequently review the Important Safety Precautions in Section 1. Be sure the operator is equipped with proper gloves, clothing, eye and ear protection. Make sure no part of the operator's body comes into contact with the workpiece while the torch is activated.

CAUTION

Sparks from the cutting process can cause damage to coated, painted, and other surfaces such as glass, plastic and metal.

NOTE

Handle torch leads with care and protect them from damage.

A. Piloting

Piloting reduces parts life more than actual cutting because the pilot arc is directed from the electrode to the tip rather than to a workpiece. Whenever possible, avoid excessive pilot arc time to improve parts life.

B. Torch Standoff

Improper standoff (the distance between the torch tip and workpiece) can adversely affect tip life as well as shield cup life. Standoff may also significantly affect the bevel angle. Reducing standoff generally results in a more square cut.

C. Edge Starting

For edge starts, hold the torch perpendicular to the workpiece with the front of the torch tip at the edge of the workpiece, not touching, at the point where the cut is to start. When starting at the edge of the plate, do not pause at the edge and force the arc to "reach" for the edge of the metal. Establish the cutting arc as quickly as possible.

D. Direction of Cut

The plasma gas stream swirls as it leaves the torch. The purpose of the swirl is to maintain a smooth column of gas. The swirl effect results in one side of a cut being more square than the other. Viewed along the direction of travel, the right side of the cut is more square than the left.

E. Dross

When dross is present on carbon steel, it is commonly referred to as either "high speed, slow speed, or top dross". Dross present on top of the plate is normally caused by too great a torch to plate distance. "Top dross" is normally very easy to remove and can often be wiped off with a welding glove. "Slow speed dross" is normally present on the bottom edge of the plate. It can vary from a light to heavy bead, but does not adhere tightly to the cut edge, and can be easily scraped off. "High speed dross" usually forms a narrow bead along the bottom of the cut edge and is very difficult to remove. When cutting a troublesome steel, it is sometimes useful to reduce the cutting speed to produce "slow speed dross". Any resultant cleanup can be accomplished by scraping, not grinding.

F. Common Cutting Faults

1. Insufficient Penetration

a. Cutting speed too fast

b. Torch tilted too much

c. Metal too thick

d. Worn torch parts

e. Cutting current too low

f. Drag cutting above 35 amps ("Tip Saver Circuit")

2. Main Arc Extinguishes

a. Cutting speed too slow

b. Torch standoff too high from workpiece

c. Cutting current too high

d. Work cable disconnected or bad connection

e. Worn torch parts

3. Excessive Dross Formation

a. Cutting speed too slow

b. Torch standoff too high from workpiece

c. Worn torch parts

d. Improper cutting current

e. Improper gas selection for cutting material

4. Short Torch Parts Life

a. Oil or moisture in air source

b. Exceeding system capability (material too thick)

c. Excessive pilot arc time

d. Air flow too low (incorrect pressure)

e. Improperly assembled torch

f. Incorrect torch parts for the operation

g. Non-Genuine Thermal Dynamics parts used

4.05 Troubleshooting Guide - General Information

WARNING

There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have had training in power electronics measurement and troubleshooting techniques.

A. Basic Troubleshooting

For basic troubleshooting and parts replacement, refer to Operating Manual. This manual should be your first resource for troubleshooting. If the problem cannot be remedied using the Operating Manual, refer to the advanced troubleshooting in this Service Manual.

B. Advanced Troubleshooting

This manual provides advanced troubleshooting and parts replacement not covered in the basic troubleshooting section of the Operating Manual. In most cases, it requires Power Supply disassembly and live measurements.

Troubleshooting and repair of this unit is a process which should be undertaken only by those familiar with high voltage high power electronic equipment.

If major complex subassemblies are faulty, the faulty subassembly must be returned for repair.

NOTE

Follow all instructions as listed and complete each in the order presented.

Subsection 4.09 includes specific test procedures and LED status identification tables. The subsection is referenced by the troubleshooting guide for the specific test to be performed.

The troubleshooting guide has six subsections as follows:

Section 4.06 - Circuit Fault Isolation

Section 4.07 - Main Input and Internal Power Problems

Section 4.08 - Pilot Arc Problems

Section 4.09 - Main Arc Problems

Section 4.10 - Test Procedures

C. How to Use the Troubleshooting Guide

The following information is a guide to help the Service Technician determine the most likely causes for various symptoms. This guide is set up in the following manner:

1. Perform operational check(s) on the equipment to isolate problem to possible circuit(s) per Section 4.06, Circuit Fault Isolation. Refer to the Appendix Pages for PC Board layouts, as necessary.
2. Determine symptom and isolate to defective assembly using the following format:

X. Symptom (Bold Type)

Any Special Instructions (Text Type)

1. Cause (Italic Type)

a. Check / Remedy (Text Type)

a. Locate your **symptom** in the appropriate subsection.

b. Check the *causes* (easiest listed first) for the symptom.

c. Check the remedies listed for each cause.

3. Repair as needed being sure to verify that unit is fully operational after any repairs.

NOTES

Many signals are transferred between Printed Circuit Board Assemblies on Ribbon Cables. If these cables become faulty they can then cause various problems. ***Do not*** *forget about these cables when troubleshooting.*

While troubleshooting visually inspect the internal components for signs of overheating, fractures and damage.

4.06 Circuit Fault Isolation

This section is used before troubleshooting to help isolate the defective circuit, identify symptoms, and test the unit for proper operation.

NOTE

Follow all instructions as listed and complete each in the order presented.

Follow the instructions as given to identify the possible symptom(s) and the defective circuit. After repairs are complete then run the following tests again to verify that the unit is fully operational.

A. Initial Setup Conditions

Connect gas supply to rear of Power Supply.

Turn on gas supply and adjust the Plasma Gas Regulator to 65 psi (4.5 bar) and the Secondary Gas Regulator to 60 psi (4.1 bar).

Set the Power Supply controls as follows:

ON / OFF switch to OFF

RUN / SET switch to SET

CURRENT control potentiometer to maximum

B. Main Input and Internal Power Tests

Connect main AC power to the unit.

Set the Power Supply ON / OFF switch to ON and note the following:

- AC indicator blinks for eight (8) seconds, then steady ON
- Main Contactor energizes (clicks once) while AC Indicator is blinking
- Inrush Relay energizes (clicks once) after AC Indicator stops blinking
- TEMP Indicator OFF
- GAS Indicator ON
- Gas flows
- Fans operate
- DC Indicator OFF

Set the Power Supply RUN / SET switch to the RUN position and note the following:

- Gas Indicator goes OFF
- Gas flow stops

NOTE

This unit has a 20 second pre-purge feature which begins when the unit is turned ON. As long as the RUN/SET Switch is in the SET position, the gas will flow indefinitely. However, once the RUN/SET Switch is placed in the RUN position, the gas will stop flowing after approximately 20 seconds (The 20 seconds begins from the time the unit is turned on, not from when the unit was put in the RUN position.)

This completes the Main Input and Internal Power Tests. If the unit functions as described above, and all correct then proceed to the Pilot Arc Test below.

If the unit does not function as noted then note the symptom and proceed to Section 4.07, Main Input and Internal Power Problems.

C. Pilot Arc Test

Activate START signal from CNC or press the torch switch on the Remote Pendant to establish a pilot arc and note the following:

- Gas flows
- GAS indicator turns ON
- After preflow delay DC indicator turns ON
- Pilot arc established

This completes the Pilot Arc Test. If the above are all correct then proceed to the Main Arc Test below.

If the above does not function as noted then note the symptom and proceed to Section 4.08, Pilot Arc Problems.

D. Main Arc Test

Activate START signal from CNC or press the torch switch on the Remote Pendant to establish a pilot arc.

Bring the torch to within 1/8"-3/8" (3.2 - 9.5 mm) of the workpiece to establish the main cutting arc, and note the following:

- Main cutting arc initiates

This completes the Main Arc Test. If the above are all correct then the equipment should be operating properly. If problems still persist then contact Technical Services.

If the above does not function as noted then note the symptom and proceed to Section 4.09, Main Arc Problems.

4.07 Main Input and Internal Power Problems

NOTES

The Input PC Board has a neon light on the upper left hand corner. If AC power is present on L1, L2, L3 of the Main Contactor, the light will be on.

Refer to the Appendix Pages for PC Board Layouts, as required.

Locate your symptom below:

A. Main power line fuses blow as soon as main disconnect is closed

1. Input power cable installed incorrectly

a. Refer to Operating Manual, Section 3.07, Input Power Cable Connections, and connect input cable

B. Main power line fuses blow when unit is powered on

1. Input Bridge Faulty

a. Test Input Bridge Rectifier per Section 4.10-D; repair as necessary

2. *Faulty FET/Heatsink Assembly*

a. Check per Section 4.10-K; repair as necessary

3. *Faulty Input PC Board*

a. Test Input PC Board per Section 4.10-D; repair as necessary

C. AC indicator on front panel of power supply is OFF

1. Front Panel ON/OFF switch in OFF position

a. Place switch to ON position

2. Main power disconnect not closed

a. Close main power disconnect

3. Main power line fuses blown

a. Replace main power line Fuses

4. Defective input power cable

a. Replace input power cable

5. Improper input power line connections inside Power Supply

a. Refer to Operating Manual, Section 3.07, Input Power Cable Connections, and correct connections if necessary

6. Fuse blown inside Power Supply

a. Replace internal Fuse (F1)

7. Voltage selection plug connected incorrectly

a. Refer to Operating Manual, Section 3.06 and correct as needed

8. Faulty Auxiliary Transformer (refer to Appendix 12, 36 VAC Circuit Diagram)

Measure for 36 VAC on Logic PC Board from J1-1 to J1-5.

a. If voltage is not present, replace the Auxiliary Transformer

9. *Faulty ON/OFF switch (refer to Appendix 12, 36 VAC Circuit Diagram)*

Measure for 36VAC on the Logic PC Board between J3-2 to J3-4.

a. If voltage is not present replace the ON/OFF switch

10. Faulty Logic PC Board (refer to Appendix 12, 36 VAC Circuit Diagram)

Measure for 36 VAC on Logic PC Board from J5-1 to J5-3.

a. If voltage is not present, replace the Logic PC Board

D. AC indicator ON, TEMP indicator ON, RUN/SET Switch is in RUN position, System will not pilot

1. *Air flow through unit is restricted*

   a. Provide adequate air flow (refer to Operating Manual, Section 3.02)

2. *Exceeded duty cycle of Power Supply*

   a. Wait for fans to cool unit (refer to Section 3.03 for proper Duty Cycle)

3. *Fans not operating*

   Measure for 115 VAC on the Logic PC Board from J96-1 to J96-3 and J96-2 to J96-4.

   - If voltage is correct, replace Fan Assembly
   - If voltage is incorrect, replace Logic PC Board

4. *Faulty temperature circuit*

   a. Check temperature circuit per Section 4.10-H; repair as necessary

5. *Defective Logic PC Board*

   On Logic PC Board remove J4 and J2 connectors

   a. If TEMP Indicator stays ON then replace Logic PC Board

E. AC indicator ON; TEMP indicator OFF; No gas flow; GAS and DC indicators OFF

1. *RUN/SET switch in RUN position*

   a. Switch to SET position

2. *Gas supply not connected to unit*

   a. Connect to gas supply

3. *Gas supply not turned on*

   a. Turn gas supply on

4. *Faulty RUN/SET switch*

   a. Check continuity

5. *Faulty gas solenoid circuit*

   a. Test gas solenoid circuit per Section 4.10-I; repair as necessary

F. AC indicator ON; GAS indicator OFF; Gas flows; DC indicator OFF

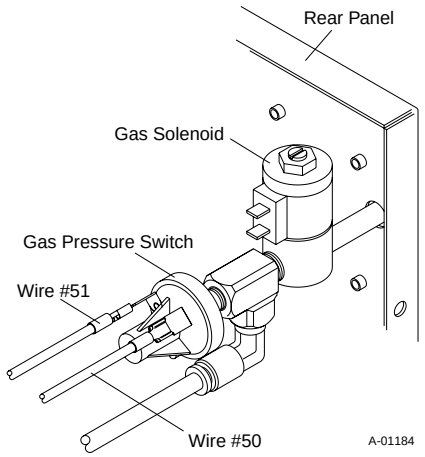
1. *Gas pressure too low*

   a. Set pressures above 35 psi (2.4 bar) limit of Plasma Pressure Switch

2. *Faulty pressure switch*

   Measure for DC voltage from wire #51 to wire #50 at the gas Pressure Switch at the rear of the Rear Panel Assembly.

   a. If 12 vdc is present and pressure is above 35 psi (2.4 bar), replace gas Pressure Switch.



3. *Low or No Coolant Flow*

   a. Check for proper coolant level. If low, fill to correct level.

   b. Check pump for proper operation (running) and replace pump if necessary.

4. *Clogged coolant filter and/or in-line coolant filter*

   a. Check internal and external coolant filters. Clean or replace if necessary. Flush the old coolant from the system.

5. *Clogged torch leads*

   a. Check torch and leads and replace if necessary. Flush the old coolant from the system.

6. *Faulty Flow Switch (FS1) or Logic PC Board*

   a. Check the coolant flow switch and Logic Board as follows:

      The flow switch (FS1) for the coolant is calibrated for 0.25 gpm. When adequate coolant flow satisfies FS1, it closes, connecting J99-1 on the Logic PC Board to J99-3 (common).

      Measure voltage between J99-pin 1 and J99-pin 3. If J99-1 is greater than 2 volts, FS1 or connections to FS1 are faulty. If the voltage is less than 2vdc, the Logic Board may be faulty. Replace the flow switch or Logic Board as necessary.

G. AC Indicator ON; GAS Indicator ON; gas flows continually

1. *RUN/SET Switch in the SET position.*

   a. Place Switch in RUN position.

2. *Faulty Gas Solenoid(s) or Logic PC Board*

   a. Turn the ON / OFF Switch to the OFF position.

   - If the gas continues to flow, check the air filters or replace Solenoid(s).
   - If the gas flow stops, replace the Logic PC Board.

H. AC indicator ON; Gas flows; GAS and DC indicators ON; Arc in torch without activating START signal; D26 (START enable) on Logic PC Board ON

1. *Faulty Remote Pendant switch*

   a. Check continuity

2. *Faulty CNC Cable*

   a. Disconnect the CNC Cable from the J22 connector. If the arc shuts off, the controller is supplying a START signal.

3. *Faulty Pilot Output Board*

   a. Turn unit off.

   b. Disconnect J12 and J13 from Pilot Output PC Board, then check continuity at J12 pin 1 and pin 3 on the Pilot Output Board. If shorted, replace Output PC Board.

4. *Faulty Logic Board*

   a. Disconnect J5 connector from Logic PC Board. If D26 stays on, replace Logic PCB. If D26 goes out, check wiring to J5 connector from Pilot PC Board.

4.08 Pilot Arc Problems

NOTE

Refer to the Appendix Pages for PC Board Layouts.

Locate your symptom below:

A. AC Indicator ON; gas flows; GAS Indicator ON when START signal is activated; DC Indicator OFF or flashes once. No spark or momentary spark at torch

Measure for 320 vdc at Input PC Board between terminal E8 wire #8 to E3 wire #9. If voltage is present, go to #4, Faulty Logic or Gate PC Board.

1. *Faulty Input "W" Contactor.*

   a. If Input "W" Contactor is not closing then measure the coil for 120VAC between wires #55 & #59.

   - If voltage is not present, go to the next step.
   - If voltage is okay, then replace Input "W" Contactor.

2. *Faulty Logic PC Board*

   a. Measure for 120VAC at the Logic PC Board connector J2-1 and J2-4.

   - If voltage is present, then check connections to "W" coil.
   - If voltage is not present, measure for 120VAC input to the Logic PC Board between J1-2 and J1-6.
     - If voltage is present, replace the Logic PCB.
     - If voltage is not present, continue to next step.

3. *Faulty Auxiliary Transformer (T3)*

   a. Measure for 120VAC between T3 connector J30-2 to J30-6.

   - If voltage is okay, check connections to Logic PC Board.
   - If voltage is not present, replace the T3 Auxiliary Transformer.

NOTE

For #4 through #6 below, J-11 should be disconnected and isolated from the CD PC Board and the torch switch will need to be closed.

4. *Faulty Logic PC Board or Gate PC Board (see note above)*

   a. Close the torch switch. The LED D20 on the top Gate PC Board should turn off.

   - If LED D20 does not turn off, measure for 12 vdc to drop to less than 2 vdc between J9-12 to J9-11.
     - If voltage does not drop, replace the Logic PC Board.
     - If voltage drops to less than 2 vdc, replace the Gate Drive PC Board.
   - If LED D20 does turn off, D4 should flash on / off once two seconds later.
     - If D4 does not flash on / off once, measure for 12 vdc to drop to less than 2 vdc momentarily, between J9-14 to J9-13 on the top Gate Drive PC Board.
       - If the voltage does not drop momentarily, then replace the Logic PC Board.
       - If the voltage does drop momentarily, replace the Gate Drive PC Board.
   - If D4 on the Gate PC Board does flash for two seconds after D20 turns off, then go to the next step.

5. *Faulty Torch or Leads (see note above)*

   a. Remove wire 15 from Pilot Output PC Board terminal E24.

   b. Following the procedure detailed in 4.10-K.1, measure the output voltage at the FET Heatsink Assembly between E-17 & E-18. If voltage is okay with wires disconnected, repair or replace torch / leads as required.

6. *Faulty Output Pilot PC Board (see note above)*

   a. Test per section 4.10-J. repair as necessary.

   b. Disconnect and isolate wires from E8 on Pilot Output PC Board.

   c. Following the procedure detailed in 4.10-K.1, measure the output voltage at the FET Heatsink assembly between E-17 & E-18. If voltage is okay with wires disconnected, replace Output Pilot PC Board.

7. *Faulty FET PC Board*

   a. Check per section 4.10-K. Repair or replace as necessary.

B. AC indicator ON; Gas flows; GAS indicator ON; DC indicator blinks; Small arc may be visible in torch

1. *Shorted torch*

   a. Remove torch from bulkhead connections. Measure between Pilot Return Lead and Torch (-). If the meter doesn't show an open, repair torch.

2. *Faulty Pilot Output PC Board*

   a. Test per Section 4.10-J; repair as necessary

3. *Faulty FET/Heatsink Assembly*

   a. Check per Section 4.10-K; repair as necessary

C. AC indicator ON; Gas flows; GAS and DC indicators ON; No arc in torch; No arc at spark gap on CD PC Board; CD enable indicator D25 on Logic Board ON

1. *Faulty CD PC Board*

   Measure DC voltage between J11-4 to J11-5 on CD PC Board

   a. If voltage is less than 2 vdc replace CD PC Board

D. AC indicator ON; Gas flows; GAS and DC indicators ON; Spark at gap on CD PC Board and CD enable indicator (D25) on Logic PC Board ON; No arc or intermittent arc in torch

1. *Gas pressure(s) set incorrectly (too high)*

   a. Check gas pressures. Plasma Gas Pressure should be 65 psi (4.5 bar), and Secondary Gas Pressure should be 60 psi (4.1 bar).

2. *Oil/moisture in air lines*

   a. Purge system. If problem corrected add filters in line with air source

3. *Incorrect torch parts*

   a. Refer to appropriate Torch Instruction Manual

4. *Faulty leads*

   a. Check continuity per appropriate Torch Instruction Manual

5. *Faulty torch*

   a. Check continuity per appropriate Torch Instruction Manual

6. *Faulty connection of wire #15 or #17 to Pilot Output PC Board or pilot inductor wires reversed with wire #17.*

   a. Check wiring connection

7. *Faulty Pilot Output PC Board*

   a. D5 on the Pilot PC Board should turn on two seconds after the START signal is activated.

      - If D5 does turn ON, install a jumper between E22 and E8 on the Pilot PC Board. If unit will pilot with jumper installed, replace the Output PC Board.

      - If D5 does not turn ON, measure the 12 vdc to drop to less than 2 vdc between J13-18 & J13-17 two seconds after START signal is activated. If voltage does drop, then measure for 36 VAC between J13-14 & J13-15. If 36VAC is found then replace the Pilot / Output PC Board.

8. *Faulty Logic PC Board*

   a. If the voltage between J13-18 & J13-17 on the Pilot / Output PC Board does not drop to less than 2 vdc two seconds after the START signal is activated, replace the Logic PC Board.

4.09 Main Cutting Arc Problems

NOTE

Refer to the Appendix Pages for PC Board Layouts.

Locate your symptom below:

A. Main cutting arc will not initiate

1. *Work cable not connected.*

   a. Connect work cable.

2. *Faulty INR Inrush Contactor*

   a. While attempting to transfer, measure for 0 vdc at input PC Board between E1 and E8.

   - If the voltage is correct, then replace the INR Inrush Contactor.

   - If voltage is not 0 vdc then measure for 120VAC at INR inrush contactor coil wires #68 and #69.

3. *Faulty Logic PC Board*

   a. If 120VAC is not found at INR Inrush Contactor wires #68 and #69, measure for 120VAC at the Logic PC Board between J17-4 to J17-8.

      - If 120VAC is not present, replace the Logic PC Board.

      - If 120VAC is present, check wiring.

4. *Faulty Current Sensor PC Board*

   Check the following:

   a. While trying to initiate main cutting arc, measure the voltage at J99-6 to J99-7 (or TP 10 to Gnd) indicators inside the Power Supply.

      - If voltage is approximately 12 vdc replace the Current Sensor.

      - If voltage is less than 2 vdc replace the Logic PC Board.

5. *Faulty Transfer Mod Enable Signal*

   a. Test this Signal by measuring J4-6 to J4-8.

      - If voltage approximately 12 vdc, replace Logic Board

      - If 0 vdc, replace Gate Drive Board

B. When operating at amperages over 35 amps the amperage drops off after main cutting arc initiates

Check whether Drag indicator (D31) on the Logic PC Board is ON when the torch tip comes in contact with the workpiece.

1. *Cutting tip in contact with the workpiece.*

   a. Maintain standoff distance 1/8"-3/8" between cutting tip and workpiece.

2. *Faulty Logic PC Board*

   If torch tip is off the workpiece and the drag indicator, D31, on the Logic PC Board is still ON, then replace the Logic PC Board.

C. Standoff Control Not Working Correctly

Refer to Troubleshooting in the Standoff Control Instruction Manual.

4.10 Test Procedures

The test procedures in this subsection are referenced in the troubleshooting section.

A. Safety Precautions

1. Significant DC Voltage exists after removal of input power. Allow 2 minutes for discharge time. Voltage measured on input capacitors must be zero before performing service on the power supply.
2. Do Not touch electrical components with any part of the human body when power is applied.
3. Keep away from any moving parts.
4. Hot surfaces can cause severe burns. Allow equipment to cool before servicing.
5. Electrostatic discharge can damage printed circuit board assemblies. Transport printed circuit boards in proper anti-static shielded packages. Use proper grounding techniques with wrist strap before handling printed circuit boards.
6. Misaligned plugs can cause printed circuit board damage. Be sure plugs are properly aligned and completely seated.
7. Excessive pressure can damage printed circuit board. Use only minimal pressure and gentle movement when disconnecting or connecting printed circuit board plugs.

B. Opening Power Supply Enclosure

The left side panel of the Power Supply must be removed to gain access to the input power connections and the input voltage selection.

WARNING

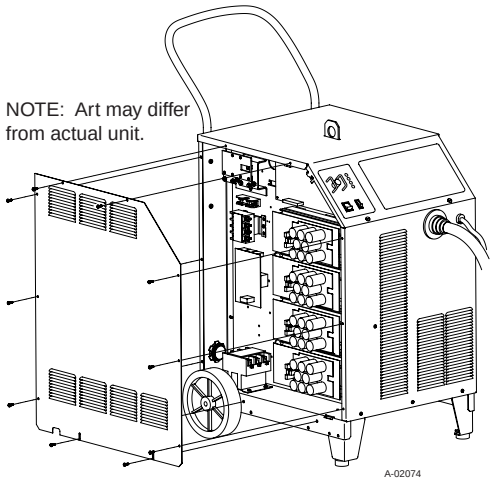
Disconnect primary power at the source before assembling or disassembling the Power Supply, torch parts, or torch and leads assemblies.

1. Remove input power from the unit.
2. Loosen the two bottom screws in the slotted holes of the desired Side Panel (viewed from the front of the unit).
3. Remove the remaining screws which secure the Side Panel to the Power Supply.
4. Pull the top of the Side Panel out and then lift up to remove the panel from the Power Supply a short distance (see NOTE).

NOTE

There is a ground wire connection to the Side Panel on the inside of the unit.

5. Remove the nut securing the ground wire to the side panel and remove the ground wire.
6. Remove Side Panel from unit and set aside.

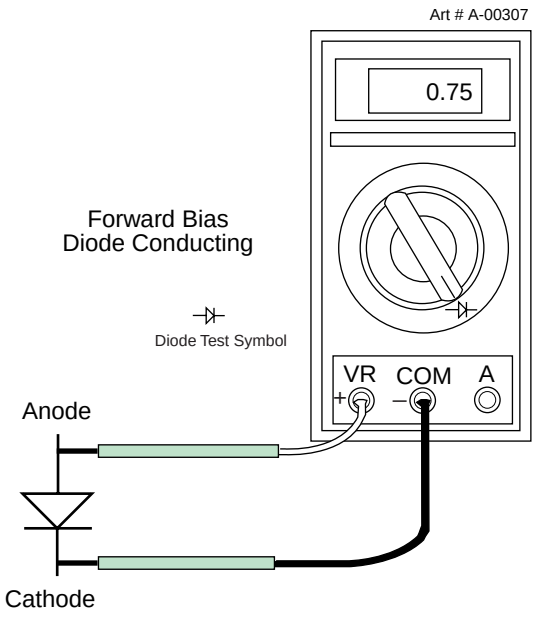


7. Reinstall the Side Panel as follows:
   a. Reconnect the ground wire to the Side Panel, if disconnected.
   b. Place the Side Panel onto the frame and slide the top edge under the lip on the Top Panel.
   c. Reinstall all the screws to secure the Side Panel.

C. Diode Testing Basics

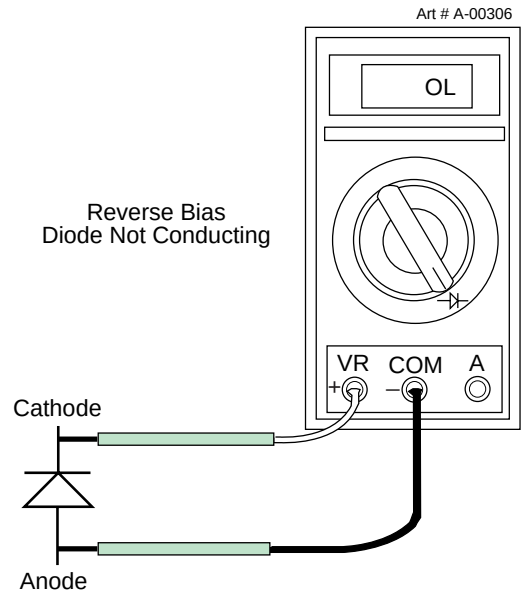
Testing of diode modules requires a digital volt / ohmmeter that has a diode test scale. Remember that even if the diode module checks good, it may still be bad. If in doubt, replace the diode module.

1. Locate the diode module to be tested.
2. Remove cables from mounting studs on diodes to isolate the module.
3. Set digital volt / ohmmeter to diode test scale.
4. Using the Figures for each test, check each diode in the module. Each diode must be checked in forward bias (plus to negative) and reverse bias (negative to plus) direction.
5. Connect the volt / ohmmeter positive lead to the anode (+) of the diode and the negative lead to the cathode (-) of the diode for forward bias testing (refer to following figure). A properly functioning diode will conduct in the forward bias direction and indicate between 0.3 to 0.9 volts.



Testing Diode Forward Bias

6. Reverse the meter leads across the diode for reverse bias testing (refer to following figure). A properly functioning diode will block in the reverse bias direction and depending on the meter function will indicate an open or "OL".



Testing Diode Reverse Bias

7. If a diode checks bad, replace the diode module.
8. Reconnect all cables to proper terminals.

D. Input PC Board /Input Bridge Rectifier Test

Locate the Input PC Board and check for shorted input diode.

NOTE

Refer to the Appendix Pages for PC Board Layouts.

Remove AC power and with an ohmmeter set on the diode range make the following checks:

Meter (+)	Meter (-)	Indication
A	(-)	Open
B	(-)	Open
C	(-)	Open
A	(+)	Diode Drop
B	(+)	Diode Drop
C	(+)	Diode Drop
(+)	(-)	Open

The meter should indicate a diode drop in one direction and an open in the other direction for each check.

If Input Bridge Rectifier diode(s) shorted, make the following checks with an ohmmeter at the Main Contactor:

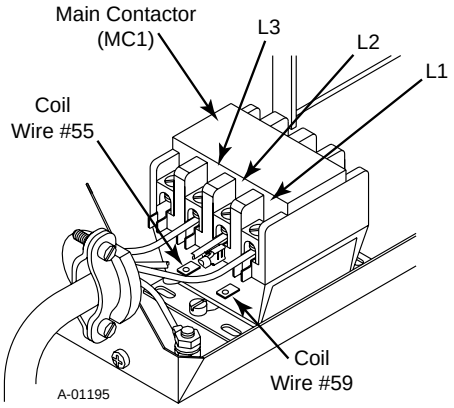
Meter (+)	Meter (-)	Indication
L1	T1	Open
L2	T2	Open
L3	T3	Open

If any test has resistance, then replace the Main Contactor also.

E. Main Contactor (MC1) Test

Reconnect power and observe proper start-up procedure. Indicator D47 on the Logic PC Board should be ON. If indicator D47 is OFF there is no voltage to the Power Supply or an overvoltage condition exists.

If indicator D47 is OFF check L1, L2, and L3 for proper AC input voltage.



Measure voltage on coil of contactor, approximately 115 VAC between wires #55 and #59.

- If voltage is correct, replace Main Contactor.
- If voltage is incorrect, replace Logic PC Board.

NOTE

The Main Contactor was located in the Base on earlier units and on the Center Chassis for current units.

F. Inrush Relay Test

If after approximately 8 seconds, the Inrush Relay does not engage, measure for 115VAC on wires #68 and #69. If there is voltage, replace Contactor. If there is no voltage, measure at Logic Board J17- 4 to J17-8. If there is no voltage at the Logic Board, replace Logic Board.

G. Blown Fuse (F1) Test

1. The voltage selector set to the wrong input voltage will cause F1 to fail.
   a. Verify input voltage with Voltage Selector.
2. A shorted or frozen pump / motor will cause F1 to fail. To check the motor:
   a. Replace F1 fuse and unplug J32
   b. Turn power on if fuse is okay.
      - Check motor connections
      - Check voltage to motor connector

H. Temperature Circuit Test

The Power Supply has seven temperature sensing switches.

- One on each FET Heatsink Assembly (four total)
- One located behind the Input Board near the Input Bridge Diode.
- One on the Pilot / Output Heatsink
- One on the Radiator

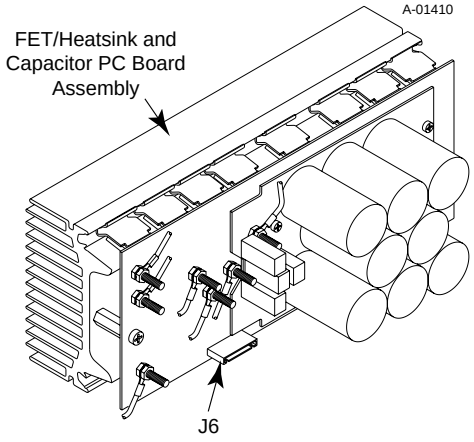
If any one of these sense over-temperature, the Overtemp Indicator on the Access Panel will light and not allow DC output.

NOTE

Refer to the Appendix Pages for PC Board Layouts.

Test the temperature circuit as follows:

1. Place the front panel ON / OFF switch to the OFF position.
2. Disconnect ribbon cable from the FET / Heatsink Assembly at J6.



3. Place the front panel ON / OFF switch to ON.
4. Check the status of the TEMP indicator.
   a. If indicator has gone OFF, then remove power and replace the corresponding pair of FET / Heatsink Assemblies.

CAUTION

The FET / Heatsink Assemblies are matched and balanced during production and must be replaced in pairs.

   b. If the indicator is still on, go to the next step.

5. Place the front panel ON / OFF switch to the OFF position.
6. Disconnect ribbon cable from the next FET / Heatsink Assembly at J6.
7. Place the front panel ON / OFF switch to ON.
8. Check status of the TEMP Indicator. If Indicator is OFF, remove power and replace the corresponding pair of FET / Heatsink Assemblies.
9. Repeat steps 1-8 for each FET Assembly.

   If the TEMP Indicator is still on, go to the next step.
10. Check the Temperature Switch at the Input Bridge Diode, by completing the following:

    a. Make sure power is off at the wall disconnect.

    b. Remove one connection from the Temp switch located behind the Input PC Board.

    c. Turn the unit back on.

    - If the Temp Indicator is off, remove power and replace Temp Switch.
    - If the Temp Indicator is still on, go to the next step.
11. Check the Pilot / Output Board.

    a. Remove power then disconnect J13 on Pilot Output Board

    b. Turn power back on and check the TEMP Indicator.

    - If the Indicator has gone off, replace Pilot Output PC Board.
    - If the TEMP Indicator is still on, continue with the next step.
12. Unplug J2 on the Logic Board.
13. Place the ON / OFF switch in the ON position.

    - If the TEMP indicator is off replace the Temperature Switch on the Radiator.
    - If the TEMP indicator is still on replace the Logic Board.

I. Gas Solenoid Circuit Test

NOTE

Refer to the Appendix Pages for PC Board layouts, as required.

Make the following voltage checks per the circuit diagram and replace the faulty part as required.

1. Place the RUN / SET Switch in the SET position and check for 115 VAC from wire #56 to wire #52 at the plasma gas Solenoid.

   - If approximately 115 VAC replace Solenoid.
   - If no voltage is present proceed to Step 2.
2. Measure for 115 VAC from J2-2 to J17-3 at the Logic PC Board.

   - If voltage is not correct replace Logic PC Board.
3. Check for 115VAC from wire #64 to wire #65 at the secondary gas Solenoid.

   - If approximately 115VAC is present, replace Solenoid.
   - If no voltage is present, proceed to step 4.
4. Measure for 115VAC from J17-7 to J2-6 at the Logic Board.

   - If the voltage is not correct, replace the Logic Board.

J. Pilot Arc Circuit Test

NOTE

Refer to the Appendix Pages for PC Board Layouts.

Check across E23 to E24 at the Pilot Output PC Board. There should be a diode drop across E23 to E24 in one direction and an open in the other.

If shorted remove the wires at E23 and E24 at the Pilot Output PC Board and check again.

Replace Pilot Output PC Board if shorted from E23 to E24 (with wires removed).

K. FET/Heatsink Circuit Tests

NOTE

Refer to the Appendix Pages for PC Board Layouts.

The FET / Heatsink circuit tests require various checks to isolate the possible fault to the FET / Heatsink Assembly.

There are several internal indicators (LED's) on the Logic PC Board, Pilot / Output PC Board and the Gate Drive PC Board to help in troubleshooting. They are as follows:

NOTES

The upper FET Assemblies provide the power for piloting and the main cutting arc. The lower FET Assemblies are for main cutting arc only.

The upper Gate Drive Board controls the upper two FET/Heatsink Assemblies and the lower Gate Drive Board controls the bottom two FET/Heatsink Assemblies.

1. No DC Output

An open circuit voltage of approximately 280 to 325 vdc (depending on input power selected) is produced when switching transistors in the FET / Heatsink Assemblies are turned ON by a PWM Enable signal from the Logic PC Board. A circuit on the Logic PC Board monitors the output voltage. When the output voltage drops below 60 vdc, indicating a problem exists, the Logic PC Board sends a signal which turns OFF the PWM Enable signal to the Gate Drive PC Board. Because this happens in less than 50 milliseconds, it is not easy to take voltage readings to find the source of the problem.

When the unit is at “idle” the AC OK indicator, D47, should be ON. The Torch Switch Enable indicator, D26, turns ON when the torch switch is pressed. At this point the gas begins to flow. When the preflow time is over the PWM Enable signal is given and the DC indicator at the front panel turns ON.

If the front panel DC Indicator turns ON then OFF immediately, the following test should be performed:

a. Disconnect J11 from the CD PC Board to disable the CD signal.

b. Connect a jumper between TP1 and TP8 on Logic PC Board. This will cause the gas to flow continuously and the DC Indicator on the front panel to turn ON.

WARNING

Connector J11 on the CD PC Board must be disconnected to prevent electrical damage to measuring equipment when testing the open circuit voltage (OCV).

c. Press and hold the hand torch switch (Logic PC Board Start Indicator, D26, turns ON).

d. Measure open circuit voltage between E8 (+) to E7 (-) at the Pilot Output PC Board. If voltage is low, each FET / Heatsink Assembly should be tested individually.

2. FET/Heatsink Output Diode Checks

Remove input power from the unit.

Isolate each FET / Heatsink Assembly by removing the red wire #12 at E18 and the black wire #11 at E17 on each FET / Heatsink Assembly. With an ohmmeter set on the diode range, check between the two output studs, E17 (- output) to E18 (+ output). This should indicate a diode drop in one direction and open in the other.

If the checks indicate shorted or open in both directions then the faulty pair of FET / Heatsink Assemblies should be replaced.

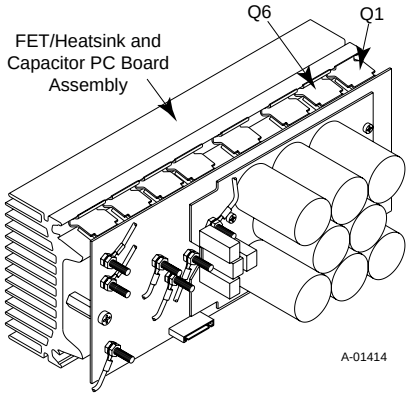
CAUTION

The FET / Heatsink Assemblies are matched and balanced during production and must be replaced in pairs.

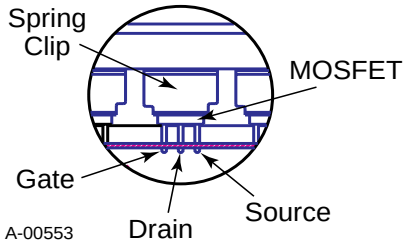
3. MOSFET Resistance Checks

The Power Supply contains four identical FET / Heatsink Assemblies. On each assembly there are two MOSFET devices that must be checked. Use an ohmmeter to check for the proper resistance of the MOSFET's as follows:

a. Locate Q1 and Q6 on the FET / Heatsink Assembly.



b. Place the meter (+) lead on gate lead of Q1 and meter (-) lead on source lead of Q1. The meter should indicate approximately 2.5K ohms.



c. Place the meter (+) lead on drain lead of Q1 and meter (-) lead on source lead of Q1. The meter should indicate >100K ohms.

NOTES

Make measurements near the body of each MOSFET.

Be sure that the meter lead probes penetrate the protective coating on the MOSFET.

d. Place the meter (+) lead on drain lead of Q1 and meter (-) lead to the heatsink. The meter should indicate >1 meg ohms.

e. Place the meter (+) lead on gate lead of Q6 and meter (-) lead on source lead of Q6. The meter should indicate approximately 2.5K ohms.

f. Place the meter (+) lead on drain lead of Q6 and meter (-) lead on source lead of Q6. The meter should indicate >100K ohms.

4. FET Reset Diode Check

Use an ohmmeter set to the diode function and check the reset diode as follows:

a. Place the meter (+) lead on E14 and the meter (-) lead on E12 of the FET / Heatsink Assembly Capacitor PC Board to check the reset diode. The meter should indicate between 0.4 to 0.6 volts using the diode function.

b. Reverse the meter leads and the indication should be a capacitor charging.

c. Place the meter (-) lead on E14 and the meter (+) lead on E13 of the FET / Heatsink Assembly Capacitor PC Board to check the reset diode. The meter should indicate between 0.4 to 0.6 volts using the diode function.

d. Reverse the meter leads and the indication should be a capacitor charging.

If the indication is a short, then replace the FET / Heatsink Assembly.

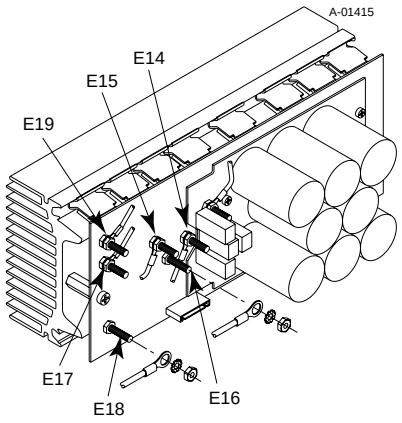
5. FET Output Rectifier Check

NOTE

Refer to the Appendix Pages for PC Board Layouts.

Use a digital meter, diode or ohms function, to check the forward and reverse bias of the output rectifiers on the FET / Heatsink Assemblies as follows:

a. Remove the wire from E16 and E18 on the Upper and Lower FET / Heatsink Assemblies.



b. Place the meter (+) lead on E16 and the meter (-) lead on E18 of the FET / Heatsink Assembly to check the output rectifier forward bias. The meter should indicate between 0.3 to 0.6 volts using the diode function or 100K ohms using the ohms function.

c. Place the meter (+) lead on E18 and the meter (-) lead on E16 of the FET / Heatsink Assembly to check the output rectifier reverse bias. The meter should indicate 'OL' using the diode function or 100K ohms using the ohms function.

d. Place the meter (+) lead on E17 and the meter (-) lead on E19 of the FET / Heatsink Assembly to check the output rectifier forward bias. The meter should indicate between 0.3 to 0.6 volts using the diode function or 100K ohms using the ohms function.

e. Place the meter (+) lead on E19 and the meter (-) lead on E17 of the FET / Heatsink Assembly to check the output rectifier reverse bias. The meter should indicate 'OL' using the diode function or 100K ohms using the ohms function.

f. Place the meter (+) lead on E18 and the meter (-) lead on the heatsink of the FET / Heatsink Assembly to check the output rectifier resistance to ground. The meter should indicate >1 meg ohms.

Replace the appropriate pair of FET / Heatsink Assemblies if any of the above tests are open or shorted.

CAUTION

The FET / Heatsink Assemblies are matched and balanced during production and must be replaced in pairs.

6. FET Output Clamp Diodes Check

NOTE

Refer to the Appendix Pages for PC Board Layouts.

Use an ohmmeter to check the resistance of the output clamp diodes, (+ out) E17 and (- out) E18, as follows:

NOTE

The wires on E16 and E18 should still be disconnected from both FET/Heatsink Assemblies.

a. Place the meter (+) lead on E17 and the meter (-) lead on E18 of the FET / Heatsink Assembly to check the output clamp diode resistance. The meter should indicate >1 meg ohms.

b. Place the meter (+) lead on E18 and the meter (-) lead on E17 of the FET / Heatsink Assembly to check the output clamp diode resistance. The meter should indicate >1 meg ohms.

Replace the appropriate pair of FET / Heatsink Assemblies if any of the above tests are open or shorted.

CAUTION

The FET / Heatsink Assemblies are matched and balanced during production and must be replaced in pairs.

SECTION 5: REPLACEMENT PROCEDURES

5.01 Introduction

This section describes parts replacement procedures and all cable repairs which may be performed on the Automated Pak Master 150XL Power Supply.

Under no circumstances are field repairs to be attempted on Printed Circuits or other Subassemblies of this unit. Evidence of unauthorized repairs may void the factory warranty.

5.02 Anti-Static Handling Procedures

A. General

CAUTION

PC Boards can be irreparably damaged by improper handling due to electrostatic discharge (ESD).

Replacement PC boards are shipped in a protective enclosure to prevent damage from electrostatic discharge (ESD) during shipping. Included with each replacement board is a ground strap to prevent static damage during installation.

WARNINGS

Read and understand these instructions and the instructions on the grounding wrist strap package before opening the equipment enclosure or removing the replacement PC Board from its protective enclosure.

Disconnect primary power to the system before disassembling the torch, torch leads, or power supply enclosure.

Do not operate the equipment or test equipment under power while wearing the grounding wrist strap.

B. Procedure

1. Open the wrist strap and unwrap the first two folds of the band. Wrap the adhesive side firmly around your wrist.
2. Unroll the rest of the band and peel the liner from the copper foil at the opposite end.
3. Attach the copper foil to a convenient and exposed electrical ground.
4. Connect the equipment primary cable ground to the same electrical ground as the wrist strap.
5. Open the equipment enclosure (see instruction manual for the appropriate equipment) and remove the failed PC Board.
6. Carefully open the ESD protective bag and remove the replacement PC Board.
7. Install the replacement PC Board in the equipment and make all necessary connections.
8. Place the failed PC Board in the ESD protective bag and seal for return shipping.
9. Reassemble the equipment enclosure (see instruction manual for the appropriate equipment).
10. Remove the grounding wrist strap from your wrist and from the electrical ground connection before reconnecting primary power to the equipment.

5.03 Parts Replacement - General Information

The parts replacement procedures described in this manual require that the Power Supply be disassembled. The part to be replaced will determine to what extent the Power Supply must be disassembled.

Before disassembling any part of the Power Supply first read the procedure for the part to be replaced, then proceed with the disassembly.

NOTES

Before removing any electrical connection mark each wire with the connection designation. When reassembling this makes sure the wires go to the proper terminals.

Note the routing of wires and make sure the wires are put back in the same place when reassembling the unit.

Turn OFF all gas inputs to the Power Supply at the source before disconnecting any gas Hose Assemblies.

Each Subsection is referenced to Section 6 for parts lists and overall detailed drawing.

WARNING

Disconnect primary power from the source before opening or disassembling the power supply. Make sure AC indicator on the Power Supply front panel is OFF.

5.04 Major External Parts Replacement

NOTE

Refer to Section 6.03 for parts list and overall detail drawing.

A. Left or Right Side Panel Replacement

1. Remove input power from the unit.
2. Loosen the two bottom screws in the slotted holes of the desired Side Panel (viewed from the front of the unit).
3. Remove the remaining screws which secure the Side Panel to the Power Supply.
4. Pull the top of the Side Panel out and then lift up to remove the panel from the Power Supply a short distance (see NOTE).

NOTE

There is a ground wire connection to the Side Panel on the inside of the unit.

5. Remove the nut securing the ground wire to the side panel and remove the ground wire.
6. Remove Side Panel from unit and set aside.

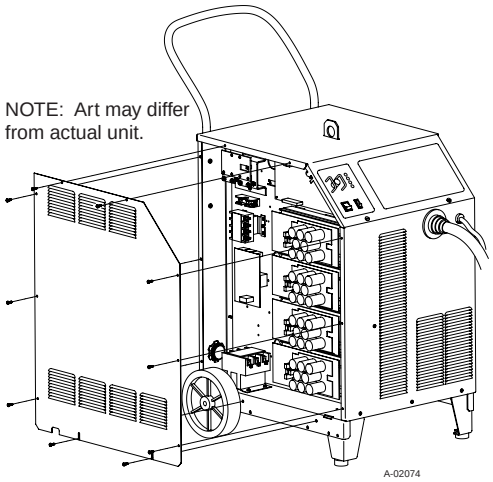


Figure 5-1 Side Panel Removal

7. Install the replacement Side Panel by reversing the above procedure doing the following:
   a. Reconnect the ground wire to the Side Panel, if disconnected.
   b. Place the Side Panel onto the frame and slide the top edge under the lip on the Top Panel.
   c. Reinstall all the screws to secure the Side Panel.

B. Top Panel Replacement

1. Remove the Left Side Panel per Section 5.04-A.
2. Remove the screws securing the Top Panel to the side and rear panels.
3. Locate and remove the nut securing the Top Panel to the center chassis.
4. Slide the Top Panel stud out of the center chassis hole.
5. Install the replacement Top Panel by reversing the above procedure.

E. Front Panel Replacement

1. Remove the Left and Right Side Panels per Section 5.04-A.
2. Remove the Work Cable from the unit per 'G' below.
3. Remove the Torch from the unit per 'H' below.
4. Remove the two bolts at the bottom of the Front Panel.
5. Remove the nuts on the inside of unit securing the Front Panel to the two studs on the center chassis.
6. Carefully remove Front Panel from the unit.
7. Install the replacement Front Panel by reversing the above procedure.

C. Work Cable Replacement

1. Remove Right Side Panel per Section 5.04-A.
2. Remove the work cable strain relief from the Front Panel.
3. Disconnect work cable connection from E8 on Pilot Output PC Board.
4. Pull the work cable through the Current Sense PC Board and then through the Front Panel, then remove from unit.
5. Install the replacement work cable by reversing the above procedure.

D. Torch & Leads Assembly Replacement

1. Open the Access Panel per Section 5.05-E.
2. Disconnect all hoses and the cable from the bulkhead.
3. Disconnect Shield Wire from Shield Stud, if present on Torch Lead
4. Install the replacement Torch Assembly by reversing the above procedure, keeping in mind the following:
   a. Connect the bottom hoses first.
   b. The two fittings on the right side of the bulkhead (when viewed from the front of unit) are for left hand hoses; the two fittings on the left are for right hand hoses.

5.05 Access Panel Parts Replacement

NOTE

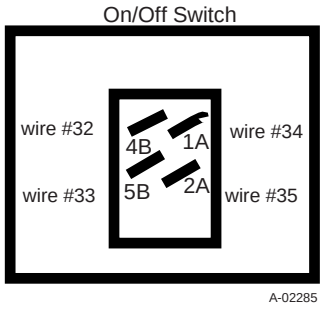
Refer to Section 6.04 for parts list and overall detail drawing.

A. CURRENT Knob Replacement

1. Turn the CURRENT adjustment fully counter clockwise and note the location of the pointer at the 30 on the knob.
2. Loosen the screw securing the Current Knob to the potentiometer shaft.
3. Remove knob.
4. Place the replacement Current Knob on to the potentiometer shaft with the location of the pointer the same as noted in step 1.
5. Tighten the screw to secure the knob to the potentiometer shaft.

B. ON/OFF Switch (SW1) Replacement

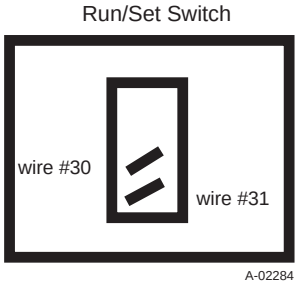
1. Unlatch the Access Panel to gain access to the rear of the ON / OFF Switch.
2. Disconnect all the wiring to the ON / OFF Switch. Wiring is as follows:



3. Squeeze the top and bottom of the switch while pulling it out of the Access Panel.
4. Install the replacement ON / OFF Switch by reversing the above procedure.

C. RUN/SET Switch (SW2) Replacement

1. Unlatch the Access Panel to gain access to the rear of the RUN / SET Switch.
2. Disconnect all the wiring to the RUN / SET Switch. Wiring is as follows:



3. Squeeze the top and bottom of the switch while pulling it out of the Access Panel.
4. Install the replacement RUN / SET Switch by reversing the above procedure.

D. Pot/LED PC Board Assembly Replacement

1. Turn the CURRENT adjustment fully counter clockwise and note the location of the pointer on the knob.
2. Loosen the screw securing the Current Knob to the potentiometer shaft.
3. Remove the Current Knob.
4. Unlatch the Access Panel to gain access to the Pot/LED PC Board.
5. Remove the Pot/LED PC Board from the four standoffs.
6. Disconnect the wire harness on Pot/LED PC Board.
7. Install the replacement Pot/LED PC Board by reversing the above procedure.

E. Access Panel Replacement

1. Turn the two Dzus studs 1/4 turn each to unlatch Access Panel from Front Panel.
2. Lift Access Panel straight up then down until the side hinges lock into place.
3. Disconnect the ground wire on the Access Panel.
4. Remove the following components from the Access Panel by referring to :
   - ON/OFF Switch per paragraph 5.05-B.
   - RUN/SET Switch per paragraph 5.05-C.
   - Current Knob and Pot/LED PC Board per paragraph 5.05-D.
5. To remove the Access Panel, lift up and pull straight out to disengage the Access Panel side hinges and remove the panel from the unit.
6. Install the replacement Access Panel by reversing the above procedure.

5.06 Left Side Center Chassis Parts Replacement

NOTE

Refer to Section 6.05 for parts list and overall detail drawing.

A. Fuse (F1) Replacement

1. Remove power from unit.
2. Remove the Left Side Panel per Section 5.04-A.
3. Remove Fuse from the fuse holder.
4. Replace Fuse (5 amp, 600V).
5. Reinstall Left Side Panel.

B. Fuse Holder Replacement

1. Remove the Left Side Panel per Section 5.04-A.
2. Remove Fuse from Fuse Holder.
3. Disconnect two wires connected to Fuse Holder.
4. Remove the two small screws securing Fuse Holder to the chassis.
5. Install the replacement Fuse Holder by reversing the above procedure.

C. Input PC Board Assembly Replacement

1. Remove the Left Side Panel per Section 5.04-A.
2. Disconnect all cable lug connections to Input Board, removing star washers and nuts where applicable.

Connection	Description of Cable
A	Cable #1 from W Contactor
B	Cable #2 from W Contactor
C	Cable #3 from W Contactor
E1	Wire #8 from Voltage Selection Base; Wires 8E from INR Contactor Positions L3 & L4
E2	Wire #8 from Voltage Selection Base; Wires 8E from INR Contactor Positions L1 & L2
E3	Wire #9 From Voltage Selection Base
E4	Wire #9 from Voltage Selection Base
E7	Wires 8E from INR Contactor Positions T3 & T4
E8	Wires 8E from INR Contactor Positions T1 & T2

NOTE

Refer to reverse side of replacement board for connection identification.

3. Remove the clear insulator sheet from the Input Board.
4. Remove the three screws in top holes connecting the Input Board to the Bridge Rectifier.
5. Install the replacement Input PC Board by reversing the above procedure noting the following:
   - The three screws securing the wiring and Input PC Board to the Bridge Rectifier must be tight enough to prevent the wires from moving.

NOTE

Failure to properly tighten the three screws securing the Input PC Board to the Bridge Rectifier will cause damage to the unit.

   - Prior to making cable connections, peel protective coating off insulator sheet and place insulator sheet on replacement input board.

D. Input Bridge Rectifier Replacement

1. Remove the Left Side Panel per Section 5.04-A.
2. Remove the Input PC Board per Section 5.06-C.
3. Remove the two nuts securing the Bridge Rectifier to the Heatsink.
4. Remove the Bridge Rectifier Assembly from the unit.
5. Remove the Thermal Pad.
6. Install the replacement Input Diode Bridge Assembly, including Thermal Pad by reversing the above procedure, noting the following:
   - Clean Heatsink and back of Bridge Rectifier surface with a clean rag and alcohol.
   - The two nuts removed in Step 3 must be torqued to 35 in-lbs when reinstalled.
   - Install Rectifier with A B C terminals away from the Thermostat.

E. Thermostat (TS2) Replacement

1. Remove the Left Side Panel per Section 5.04-A.
2. Remove the Input PC Board per Section 5.06-C.
3. Remove two screws securing the Thermostat to the Heatsink.
4. Install replacement Thermostat by reversing the above procedure.

F. In-Rush Contactor (INR) Assembly Replacement

1. Remove the Left Side Panel per Section 5.04-A.
2. Note orientation of all the wires connected to the Contactor Assembly and label them.
3. Disconnect the wires from the Contactor Assembly terminals.
4. Remove the two nuts and washers securing the Contactor Assembly to the internal chassis of the unit.
5. Install the replacement Contactor Assembly by reversing the above steps, keeping in mind the following:
   - Install Contactor with T1-T4 side towards heatsinks.

G. Logic PC Board Replacement

1. Remove the Left Side Panel per section 5.04-A.
2. Carefully remove all cable connections from the Logic PC Board noting the location of each.
3. Remove the five screws securing the Logic PC Board to the standoffs.
4. Install the replacement Logic PC Board by reversing the above procedure.

H. Gate Drive PC Board(s) Replacement

NOTE

The two Gate Drive Boards are identical and are removed in the same manner.

1. Remove the Left Side Panel per Section 5.04-A.
2. Carefully remove all cable connections to the Gate Drive PCB Assembly noting the location of each per the following chart:

Connection	Description of Cable
J7	Ribbon Cable from FET/Heatsink Assembly
J8	Ribbon Cable from FET/Heatsink Assembly
J9	Ribbon Cable from logic Board at J4 to both Gate Drives at J9
J10	Twisted 3-wire harness from J11 on top Gate Drive Board
J11	Twisted 3-wire harness from J10 on bottom Gate Drive Board

3. Remove the four screws securing the Gate Drive PC Board to the four standoffs.
4. Reinstall the replacement Gate Drive PCB Assembly by reversing the above procedure.

I. FET/Heatsink Assembly Replacement

CAUTION

The FET / Heatsink Assemblies are matched and balanced during production and must be replaced in pairs.

The four FET/Heatsink Assemblies are identical and are removed in the same manner.

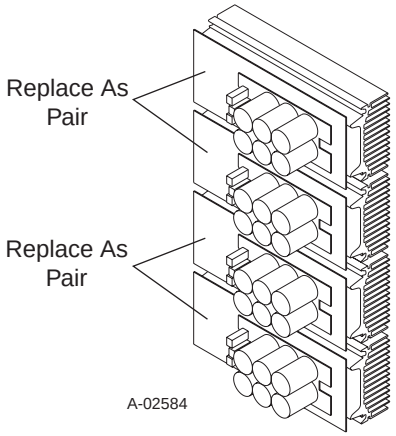
1. Remove the Left Side Panel per Section 5.04-A.
2. Remove the Ribbon Cable plugs at J6 on the FET / Heatsink Assembly. To remove the cable, push down on the locking tab and pull the cable plug out of the connector.
3. Disconnect all the wire lug connections to the FET / Heatsink Assembly.

Connection	Description
E14	Main Transformer (Primary)
E15	Main Transformer (Primary)
E16	Main Transformer (Secondary)
E17	(-) Output
E18	(+) Output
E19	Main Transformer (Secondary)

4. Disconnect the wiring from wire lug connections on the Capacitor PC Board at E25 (+) and E26 (-) terminals.
5. Remove the two screws securing the Heatsink Mounting Bracket to the chassis.
6. To remove the Mounting Bracket lift up on the top FET / Heatsink Assembly and push down on the bottom FET / Heatsink Assembly in the middle where the two FET / Heatsink Assemblies come together.
7. Slide the FET / Heatsink Assembly out and up to remove the FET / Heatsink Assembly from the unit.

NOTE

FET/Heatsink Assemblies must be replaced in pairs per the following illustration.



8. Install the replacement FET / Heatsink Assembly by reversing the above procedure.

NOTE

Be sure that the top groove in the FET/Heatsink Assembly is properly seated over the cutout in the chassis.

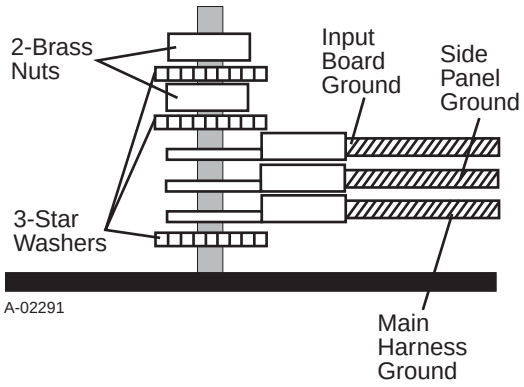
J. Main Contactor (W) Assembly Replacement

NOTE

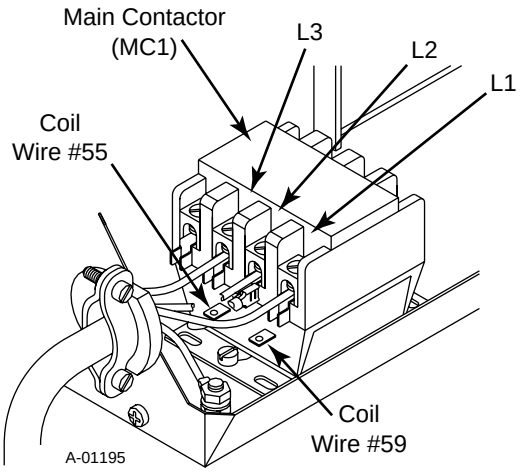
The Main Contactor was located in the Base on earlier units and on the Center Chassis for current units.

1. Remove the Left Side Panel per Section 5.04-A.
2. Note orientation of the Main Contactor and location of all wires and cables connected to the Contactor Assembly.
3. Disconnect wires and cables at Main Contactor.
4. Remove the two nuts securing the Contactor Assembly to the two mounting studs in the unit.
5. Install the replacement Main Contactor Assembly by reversing the above steps, connecting wires as follows:

   a. Connect ground wire as shown.



   b. Attach main harness wires #55 and #59 to the coil of the Contactor.



   c. Attach the main harness wires #4 & #5 to the inner prong of L1 & L2 respectively of the main contactor.

   d. Connect cables 1, 2, and 3 to T1, T2, and T3 respectively.

5.07 Right Side Center Chassis Parts Replacement

NOTE

Refer to Section 6.06 for parts list and overall detail drawing.

A. Pilot/Output PC Board Assembly Replacement

1. Remove the Right Side Panel per Section 5.04-A.

NOTES

Before removing any connection mark each wire with the connection designation to ensure that wires go to the proper terminals when reassembling. Also note the routing of wires and make sure the wires are put back in the same place when reassembling the unit.

2. Mark all wirings / connections, then disconnect all the wiring connections to the Pilot / Output PC Board Assembly.
3. Remove the four screws and washers securing the PC Board to the standoffs.
4. Install the replacement Pilot / Output PC Board Assembly by reversing the above procedure. Refer to Appendix 6 for wiring connection diagram.

B. Coolant Motor Relay (MC1) Replacement

1. Remove the Right Side Panel per Section 5.04-A.

NOTES

Before removing any connection mark each wire with the connection designation. When reassembling this makes sure the wires go to the proper terminals.

Note the routing of wires and make sure the wires are put back in the same place when reassembling the unit.

2. Mark all wirings / connections then disconnect all the wiring connections to the Relay Assembly.
3. Remove the two screws securing the Relay Assembly to the Reservoir Panel.
4. Install the replacement Relay Assembly by reversing the above procedure.

C. Pilot Resistor (R1 & R2) Replacement

NOTE

This unit has two Pilot Resistors. The replacement instructions are the same for both.

1. Remove the Right Side Panel per Section 5.04-B.
2. Remove all wiring connections to the Pilot / Output PC Board Assembly, noting the location of each.
3. Remove two nuts securing Pilot Resistor to Pilot Panel.
4. Remove Pilot Resistor from studs.
5. Install replacement Resistor by reversing the above procedure.

D. Pilot Inductor (L3) Replacement

1. Remove the Right Side Panel per Section 5.04-A.
2. Remove all wire connections to the Pilot Inductor, noting the location of each.
3. Remove four nuts securing Pilot Inductor to the Pilot Panel and remove Pilot Inductor from unit.
4. Install replacement Pilot Inductor by reversing the above steps.

E. CD PC Board Assembly Replacement

1. Remove the Right Side Panel per Section 5.04-A.

NOTES

Before removing any connection, mark each wire with the connection designation. When reassembling this makes sure the wires go to the proper terminals.

Note the routing of wires and make sure the wires are put back in the same place when reassembling the unit.

2. Disconnect all the wiring connections to the CD PC Board Assembly.
3. Remove the four screws and washers securing the PC Board to the standoffs.
4. Install the replacement CD PC Board Assembly by reversing the above procedure.

F. Coolant Filter Replacement

1. Remove Right Side Panel per Section 5.04-A.
2. Remove the two coolant hose connections to the Filter Assembly.

NOTE

Some residual coolant may drain from the In-Line Filter. It is recommended that a bucket, rag or towels be placed below the hose prior to removing.

3. Remove the two elbow fittings on each side of the Coolant Filter Assembly and remove the damaged Coolant Filter Assembly from the bracket.
4. Clean the old thread sealer from the threads of the elbow fittings.
5. Apply a thin coating of liquid Teflon thread sealer to the threads of the elbow fittings.
6. Place the replacement Coolant Filter Assembly in the bracket with the arrow pointing to the left and reinstall the two elbow fittings.
7. Reconnect the two coolant hoses to the Coolant Filter Assembly making sure that the hose to the Pump Assembly is on the output of the Coolant Filter Assembly).
8. Install Right Side Panel.

G. Coolant Reservoir Replacement

CAUTION

Handle and dispose of the used coolant per recommended procedures.

NOTE

The Coolant Reservoir is removed by removing the rear panel.

1. Remove the Left and Right Side Panels per Section 5.04-A.
2. Drain the coolant from the Coolant Reservoir as follows:
   a. Disconnect the Coolant Supply Hose input connection at the Coolant Filter Assembly. The hose goes from the Coolant Filter Assembly to the bottom of the reservoir.
   b. Place the end of the hose into a container to catch the coolant as it flows from the reservoir.

NOTE

Do Not run the pump as the coolant will gravity feed from the reservoir.

   c. Remove the Coolant Reservoir Cap then remove the Deionizer Basket and Deionizer Bag from the Coolant Reservoir filler hole.
3. Disconnect the Coolant Supply Hose output connection from the bottom of the reservoir.
4. Disconnect the In-Line Coolant Filter Assembly where it connects to the reservoir.

NOTE

Some residual coolant may drain from the In-Line Filter. It is recommended that a bucket, rag or towels be placed below the hose prior to removing.

5. Disconnect two air lines connected to the two solenoid assemblies.
6. Remove the two bottom screws on Rear Panel.
7. Remove the two nuts and washers on the inside of rear panel connecting the panel to the center chassis.
8. Remove the screw located in the center of the rear panel which secures the rear panel to the reservoir panel.
9. Carefully slide the rear panel out and away from the unit.
10. Remove the four nuts and washers (two top and two bottom) securing the coolant tank to the reservoir panel.
11. Remove the coolant reservoir from the rear panel.
12. Reinstall the replacement Coolant Reservoir by reversing the above steps, keeping in mind the following:
    - Use thread sealant on all fittings when reinstalling.
    - Refill the Coolant Reservoir with the coolant removed or fresh Thermal Arc Torch Coolant.
13. Place the Deionizer Basket and Bag into the Coolant Reservoir filler hole and install the Coolant Reservoir Cap.

H. In-Line Coolant Filter Assembly Replacement

1. Remove the Right Side Panel per Section 5.04-A.

CAUTION

Handle and dispose of the used coolant per recommended procedures.

2. Partially drain the coolant from the Coolant Reservoir as follows:
   a. Disconnect the Reservoir to Coolant Filter Assembly hose at the Coolant Filter Assembly.
   b. Place the end of the hose into a container to catch the coolant as it flows from the reservoir. Only enough needs to be removed so that the level is below the In-Line Filter / Flow Switch Assembly hole located on the end of the reservoir.

NOTE

Do Not run the pump as the coolant will gravity feed from the reservoir.

3. Remove the hose connected to the bottom of the In-Line Coolant Filter Assembly.

NOTE

Some residual coolant will drain from the In-Line Filter. It is recommended that a bucket, rag or towels be placed below the hose prior to removing.

4. Remove bowl on In-Line Coolant Filter.
5. Remove filter body from Flow Switch.
6. Remove fittings from filter body.
7. Install the replacement In-Line Coolant Filter Assembly by reversing the above procedure.

NOTE

Use thread sealant on all the pipe threads when reinstalling.

8. Refill the Coolant Reservoir with the coolant removed or add fresh Thermal Arc Torch Coolant.

I. Flow Switch (FS1) Assembly Replacement

1. Remove the Right Side Panel per Section 5.04-A.

CAUTION

Handle and dispose of the used coolant per recommended procedures.

2. Partially drain the coolant from the Coolant Reservoir until the coolant level is below where the Flow Switch connects to the Reservoir. Drain coolant as follows:
   a. Disconnect the Reservoir to Coolant Filter Assembly hose at the Coolant Filter Assembly.
   b. Place the end of the hose into a container to catch the coolant as it flows from the reservoir. Drain enough coolant so that the coolant level is below the Flow Switch Assembly connection to the reservoir tank.

NOTE

Do Not run the pump as the coolant will gravity feed from the reservoir.

3. Detach red wires at top end of Flow Switch where they connect to wire harness.
4. Disconnect In-Line Filter from the bottom of Flow Switch Assembly.

NOTE

Some residual coolant will drain from the In-Line Filter. It is recommended that a rag or towels be placed below the hose prior to removing.

5. Remove fitting from bottom end of Flow Switch Assembly.
6. Disconnect Flow Switch from Reservoir and remove Switch from unit.
7. Install the replacement Flow Switch Assembly by reversing the above steps, keeping in mind the following:
   a. The Flow Switch Assembly should be installed at a slight angle to allow room for hose attachment with the filter pointing away from the tank.
   b. Use thread sealant on all the pipe threads when reinstalling.
8. Refill the Coolant Reservoir to the full level (refer to label on coolant tank) with either the coolant that was removed or add fresh Thermal Arc Torch Coolant.

J. Output Inductor (L1 & L2) Assembly Replacement

NOTES

There are two Output Inductors in this unit. Replacement instructions are the same for both.

The Output Inductor(s) are located behind the reservoir panel. To gain access to the Output Inductor(s), the rear panel of the unit is removed, then the internal reservoir panel is disengaged and moved out of the way.

1. Remove the Left and Right Side Panels per Section 5.04-A.
2. Drain the coolant from the Coolant Reservoir as follows:
   a. Remove Reservoir Cap from Reservoir.
   b. Disconnect the Coolant Supply Hose input connection at the Coolant Filter Assembly. The hose goes from the Coolant Filter Assembly to the bottom of the reservoir.
   c. Place the end of the hose into a container to catch the coolant as it flows from the reservoir.

NOTE

Do Not run the pump as the coolant will gravity feed from the reservoir.

3. Disconnect the Coolant Supply Hose output connection from the bottom of the reservoir.
4. Disconnect the In-Line Filter Assembly where it connects to the reservoir.

NOTE

Some residual coolant may drain from the In-Line Filter. It is recommended that a rag or towels be placed below the hose prior to removing.

5. Disconnect two air lines where they connect to the two solenoid assemblies.
6. Remove the two bottom screws on rear panel.
7. Remove the two nuts and washers on the inside of rear panel connecting the panel to the center chassis.
8. Remove the rear panel from the unit by removing the screw located in the center of the rear panel which secures the rear panel to the reservoir panel.
9. Carefully slide the rear panel out and away from the unit.
10. Locate the two nuts on the base which secure the reservoir panel to the base, then remove nuts.

NOTE

It may be necessary to disconnect some wiring in order to have enough room to work. Note wire connections so that wires can be reconnected again properly.

11. Slide reservoir panel up and out of the 'T' slots on the center chassis and move panel to provide access to main transformers.
12. Complete the following:
    a. Disconnect single leg orange wire from E17 on the FET / Heatsink Assembly and slide wire back through adjacent bushing hole in center chassis.
    b. Disconnect orange wire at E3 on Pilot Output Board.
13. Note orientation of Inductor, then remove four lock nuts securing Transformer to center chassis.
14. Install the replacement Output Inductor by reversing the above procedure, keeping in mind the following:
    - Reservoir Panel must seat in corresponding center chassis slots.
    - The four screws securing the Inductor mounting plate to the center chassis should have a maximum of 2 to 5 threads protruding through the left side of the chassis.

K. Main Transformer (T1 & T2) Assembly Replacement

NOTES

There are two Main Transformers in this unit. Replacement instructions are the same for both.

The Main Transformer(s) are located behind the Reservoir Panel. In order to gain access to the Output Inductor(s), the Rear Panel of the unit must be removed and the internal Reservoir Panel disengaged and moved out of the way.

1. Remove the Left and Right Side Panels per Section 5.04-A.
2. Drain the coolant from the Coolant Reservoir as follows:
   a. Remove Reservoir Cap from Reservoir.
   b. Disconnect the Coolant Supply Hose input connection at the Coolant Filter Assembly. The hose goes from the Coolant Filter Assembly to the bottom of the Reservoir.
   c. Place the end of the hose into a container to catch the coolant as it flows from the reservoir.

NOTE

Do Not run the pump as the coolant will gravity feed from the reservoir.

3. Disconnect the Coolant Supply Hose output connection from the bottom of the Reservoir.
4. Disconnect the In-Line Filter Assembly where it connects to the Reservoir.

NOTE

Some residual coolant may drain from the In-Line Filter. It is recommended that a bucket, rag or towels be placed below the hose prior to removing.

5. Disconnect two air lines where they connect to the two Solenoid assemblies.
6. Remove the Rear Panel per procedures in Section 5.09-B.
7. Locate the two nuts on the base which secure the Reservoir Panel to the base.
8. Remove nuts.

NOTE

It may be necessary to disconnect some wiring in order to have enough room to work. Note wire connections so that wires can be reconnected again properly.

9. Slide reservoir panel up and out of the 'T' slots on the center chassis and move panel to provide access to main transformers.
10. Carefully remove all wire connections to the FET PCB Assembly noting the location of each per the following chart:

Cable #	FET PCB Connection
14A	E14
15A	E15
16A	E16
19A	E19
14B	E14
15B	E15
16B	E16
19B	E19

NOTES

Make sure white #19 wires are looped around and connected from the right side.

Transformer leads are marked 'A' & 'B'. Group 'A' is wired to the top heatsink and group 'B' is wired to the bottom heatsink. Wires are placed belly up."

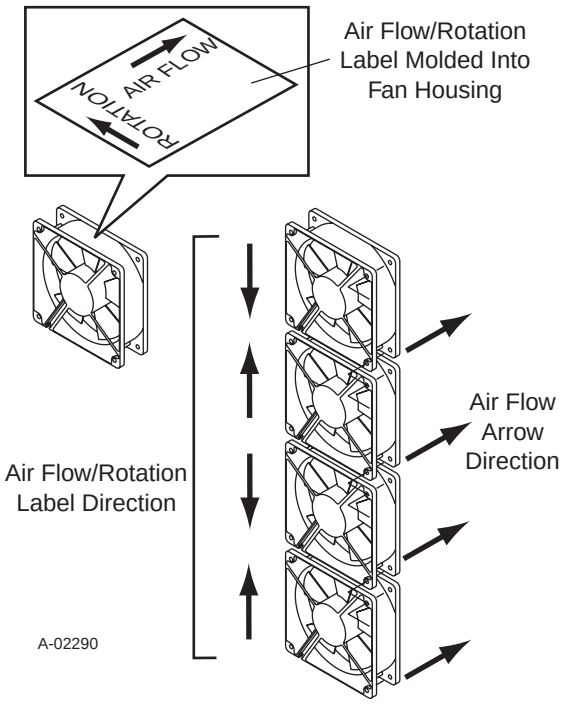
11. Note orientation of Main Transformer Assembly, then remove four lock nuts securing Transformer to the center chassis.
12. Install the replacement Transformer Assembly by reversing the above procedure, keeping in mind the following:
    - Reservoir Panel must seat in corresponding center chassis slots.
    - The four screws securing the output inductor mounting plate to the center chassis should have a maximum of 2 to 5 threads protruding through the left side of the chassis.

L. Pilot Panel Fan (M1 - M4) Replacement

NOTE

There are four Fans mounted to the Pilot Fan Panel. Replacement instructions are the same for all Fans.

1. Remove Front Panel per Section 5.04-E.
2. Remove the two screws securing the Fan to the two tabs on the Pilot Fan Panel.
3. Turn the fan sideways and pull gently out of unit to where the wires can be disconnected.
4. Carefully note wiring connections, then disconnect wires.
5. Install replacement Fan(s) by reversing the above steps, noting the following:
   a. Piggyback tabs face outside.
   b. Label faces inside unit.
   c. Position Fan so that Air Flow / Rotation Label molded into the Fan Housing is positioned as shown in the following illustration.



M. Current Sense PC Board Assembly Replacement

1. Remove the Work Cable per Section 5.04-C.
2. Disconnect the ribbon cable from the Current Sensor at J17 on the Logic PC Board.
3. Remove the Sensor by prying off standoffs at the rear of the Bulkhead, behind the Work Cable Strain Relief.
4. Install the replacement Current Sensor PC Board by reversing the above procedure.

N. CD Coil (T4) Assembly Replacement

NOTE

Prior to removal, note the location and orientation of the CD Coil Assembly and all its connections.

1. Remove the Left and Right Side Panels per Section 5.04-A.
2. Remove the Top Panel per Section 5.04-B.
3. Disconnect the coolant hose from the fitting at the end of the bulkhead adapter.
4. Drain coolant from hose into bucket.
5. Remove the first nut and washer from the bulkhead adapter.
6. Disconnect CD Coil Leads at E1 & E2 on the CD PC Board.
7. Disconnect stiff CD Coil Wire from PS(-) on Pilot Output Board.
8. Remove two screws in Ferrite U-Core attaching it to the bulkhead chassis and remove CD Coil Assembly from unit.
9. Install the replacement CD Coil Assembly by reversing the above procedure.

5.08 Base Parts Replacement

A. Wheel/Axle Assembly Replacement

- **Wheel Replacement**

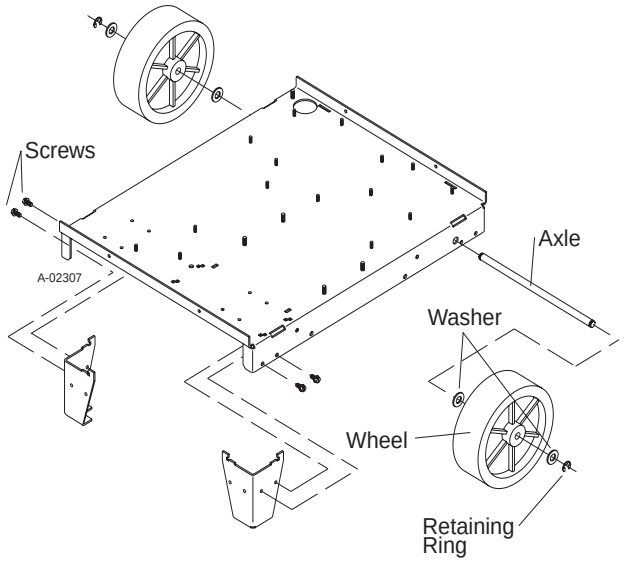
NOTE

Both Wheels are removed and replaced in the same manner.

1. Raise the unit off the floor far enough for the weight of the unit to be removed from the axle and wheels.
2. For the wheel to be replaced, remove retaining ring, washer, wheel and second washer from end of axle.
3. Install the replacement wheel(s) by reversing above procedure.

- **Axle Replacement**

1. Raise the unit off the floor far enough for the weight of the unit to be removed from the axle and wheels.
2. Remove both wheels from the axle.
3. Slide the faulty axle out of base.
4. Install the replacement axle by reversing above procedure.



B. Support Leg(s) Assembly Replacement

NOTE

Both support leg assemblies are removed and replaced in a similar manner.

1. Raise the unit off the floor far enough for the weight of the unit to be removed from the support legs.
2. Remove two screws securing support leg to front of base.
3. Install replacement support leg by reversing above step.

C. Auxiliary Transformer (T3) Assembly Replacement

NOTE

All replacement Auxiliary Transformers Assemblies include two fuses.

1. Remove the Right Side Panel per Section 5.04-A.
2. Note orientation of all the wires connected to the Auxiliary Transformer Assembly.
3. Disconnect wires.
4. Remove the four flat washers and nuts securing the Auxiliary Transformer to the four base studs.
5. Remove Transformer from unit.
6. Install replacement Transformer by reversing the above procedure.

D. Motor (M5) / Fan / Pump Replacement

NOTE

The simplest way to replace the Motor is to remove the Motor, Fan and Pump together, then replace the Motor. The procedure below describes how to remove the Motor/Fan Pump Assembly to replace the Motor. To replace the Fan, continue with the procedures outlined in Section 5.08-E, Fan Assembly Only Replacement. To replace the Pump, follow the procedures outlined in Section 5.08-F, Pump Assembly Replacement.

1. Remove the Right Panel per Section 5.04-A.
2. Disconnect the following:

NOTE

Coolant may drain from the hoses. It is recommended that a bucket, rags or towels be placed below the hose prior to removing.

   a. Radiator to In-Line Filter Hose - disconnect at Filter.
   b. Radiator to Torch Hose - disconnect at Bulkhead.
   c. Pump to Coolant Filter Hose - disconnect at Pump.
   d. Pump to Torch Hose - disconnect at Bulkhead.
   e. Remove tie wraps as necessary.

3. Note connection of all wires to Motor then disconnect wires.
4. Remove four nuts and washers securing the Motor Mount to the base, and remove Motor / Pump / Fan Assembly.
5. Replace Fan and Pump per procedures in Sections 5.08-E and 5.08-F respectively, if required.
6. Install the replacement Motor with pump and fan by reversing the above procedure (see NOTE).

NOTE

Before installing the replacement Motor, check that the internal wiring of the Motor is set for the proper input voltage per the information on the Motor nameplate.

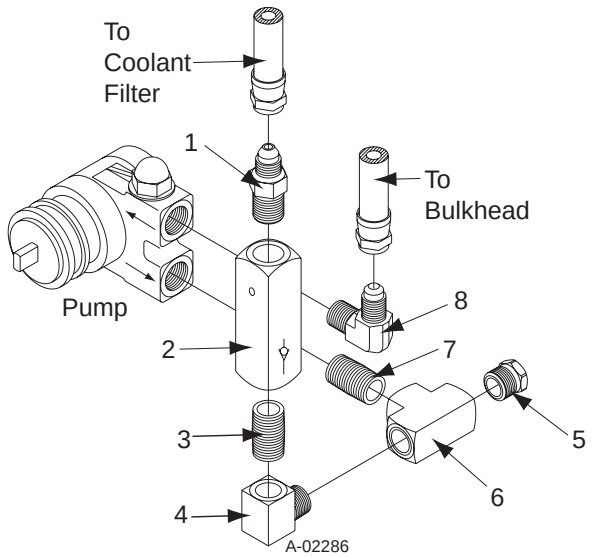
E. Fan Assembly Only Replacement

1. Remove Motor / Fan / Pump Assembly from unit per procedure in 5.08-D.
2. Loosen the fan locking screw securing the Fan to the Motor Assembly shaft and remove the Fan.
3. Install the replacement Fan by reversing the above procedure, noting the following:

   a. The fan locking screw is facing the motor and aligned with flat of shaft. The motor assembly shaft must be flush with the front part of the Fan Bushing.
   b. Apply Loctite to the fan screw before tightening.

F. Pump Assembly Replacement

1. Remove the Motor / Fan / Pump Assembly per procedure in 5.08-D.
2. Loosen the Pump Clamp securing the Pump Assembly to the Motor Assembly.
3. Note the orientation of the Pump Assembly to the Motor Assembly.
4. Pull the Pump Assembly from the Motor Assembly.
5. Disassemble the Pump Assembly in the sequence shown below, beginning with #1:



6. Install the replacement Pump Assembly by reversing the above steps, noting the following:

   a. Proper orientation of the Pump Assembly to the Motor Assembly.

   b. Install check valve with the flow marking towards the bottom (as shown above).

   c. Use thread sealant on all pipe threads (Loctite thread sealant #565, or equivalent).

7. Refill Coolant Reservoir.

8. Connect primary power and turn on unit.

G. Radiator Assembly Replacement

NOTE

The Front Panel, Right Side Panel and Motor/Fan/ Pump Assembly must be removed first in order to remove the Radiator.

1. Remove the Right Side Panel per Section 5.04-A.
2. Remove the Front Panel per Section 5.04-E.
3. Remove the Motor / Fan / Pump Assembly per Section 5.08-D.
4. Carefully disconnect Thermal Switch (solid state) near the inlet port and slide it out through hole in mounting bracket. Remove ties as required.
5. Remove (6) screws securing Radiator to frame.
6. Install the replacement Radiator by reversing the above procedure.

H. Thermal Switch (TS1) Replacement

1. Remove the Right Side Panel per Section 5.04-A.
2. Locate the Radiator and carefully disconnect the Thermostat Switch (solid state) near the inlet port and slide out through hole in mounting bracket. Remove ties as required.
3. Install the replacement Thermal Switch by reversing the above procedure.

5.09 Rear Panel Parts Replacement

NOTE

Refer to Section 6.08 for parts list and overall detail drawing.

A. Handle Replacement

1. Remove the four hex head screws securing the handle to the Rear Panel of the unit.
2. Remove the Handle from the Rear Panel.
3. To install the replacement Handle, reverse the above procedure.

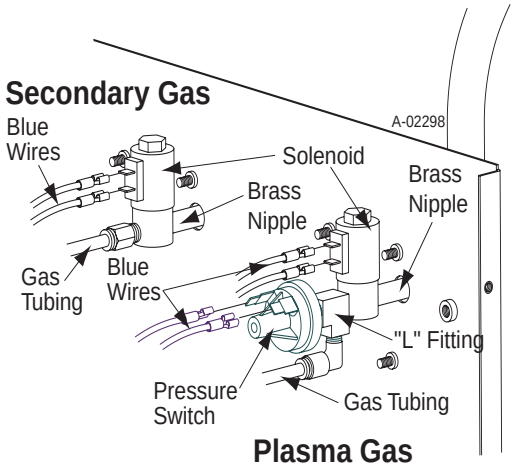
B. Rear Panel Replacement

1. Remove the Left and Right Side Panels per Section 5.04-A.
2. Remove the Top Panel per Section 5.04-B.
3. Remove the two Regulators on the Rear Panel by completing the following:

   a. Disconnect the air line hose connected to the solenoid / pressure switch assembly

   b. Disconnect the air line hose connected to the solenoid assembly.

   c. Note the location of two blue wires connected to the solenoid assembly (secondary) and four blue wires connected to the solenoid / pressure switch assembly (plasma).



   d. Disconnect wires.

   e. Note solenoid orientation then remove the solenoid assembly from the 2 inch long brass nipple and set assembly aside.

f. Note solenoid / pressure switch orientation, then remove the solenoid / pressure switch assembly from the 2 inch brass nipple, and set aside.

g. Remove the four screws securing each regulator to the rear panel and remove Regulators.

4. Remove reservoir cap from the reservoir.

5. Disconnect the following input power cable wires from Main Contactor:

   - L1, L2 & L3.
   - Ground connection to base panel.

6. Remove strain relief from rear panel**.**

7. Disconnect the two wiring connectors at J23 and J24 from the Filter / Divider PC Board.

   If CNC wiring is connected to TB1, then remove the TB1 from the PC Board. The terminal block is plugged into a socket on the Filter / Voltage Divider PC Board.

8. Remove the Filter / Voltage Divider PC Board from the Rear Panel.

9. Remove rear panel from unit by completing the following:

   a. Remove the two screws on near bottom of rear panel securing the panel to the base of the unit.

   b. Remove the two nuts and washers on the inside of rear panel connecting the panel to the center chassis.

   c. Remove screw located in the center of the rear panel securing the rear panel to the frame.

   d. Carefully lift the rear panel up, over the reservoir, and away from the power supply.

10. Install the replacement rear panel by reversing the above procedure.

C. Pressure Switch (PS1) Replacement

1. Remove the Right Side Panel per Section 5.04-A.

2. Disconnect the two wires connected to the Pressure Switch Assembly (see Figure below).

3. Remove the Pressure Switch Assembly from the T-fitting.

4. Install the replacement Pressure Switch Assembly by reversing the above procedure, keeping in mind the following:

   - Apply pipe thread sealant to the fitting before reassembling.

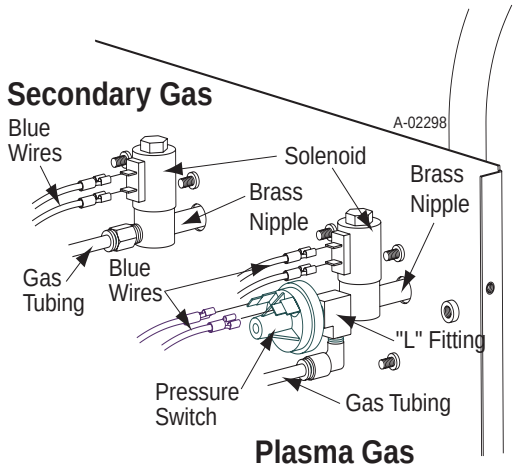
D. Solenoid Valve (SOL1 & SOL2) Replacement

NOTE

There are two Solenoid Valve Assemblies in this unit; one for plasma gas and one for secondary gas (as labeled on rear panel). The Solenoid Assembly for secondary gas has a Pressure Switch which must be removed before the Solenoid can be removed. Following the instructions as they pertain to the Solenoid Valve being replaced.

1. Remove the Right Side Panel per Section 5.04-A.

2. Locate the Solenoid Assembly to be replaced. Parts are assembled as shown below.



3. Note the location of all wires, then disconnect the following:

   a. Disconnect the gas tubing at the solenoid or "L" fitting.

   b. Disconnect blue wires.

4. Disconnect the Pressure Switch from the Plasma Gas "L" fitting, if applicable.

5. Note the orientation of the Solenoid Valve Assembly then remove the Solenoid(s) from the two inch brass regulator fitting(s).

6. Install the replacement Solenoid Valve Assembly by reversing the above procedure.

E. Air Line Regulator Bracket(s) Replacement

NOTE

There are two Air Line Regulator Brackets in this unit and both are replaced using this same procedure.

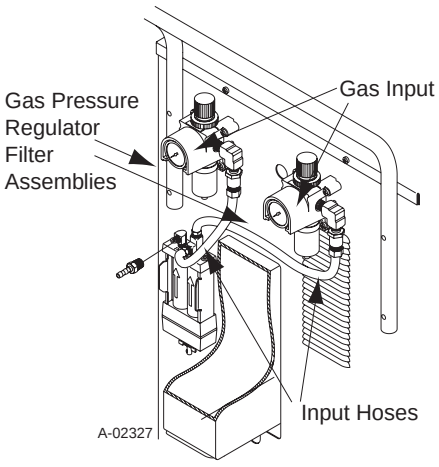
1. Remove the nut securing the Air Line Regulator to the mounting bracket.
2. Remove the four screws securing the Air Line Regulator Bracket to the Rear Panel.
3. Remove bracket from unit.
4. Install the replacement Air Line Regulator Bracket by reversing the above procedure.

F. Air Line Regulator(s) Replacement

NOTE

This unit has two Air Line Regulators - one for plasma gas and one for secondary gas. This procedure applies to both Regulators.

1. Remove the Right Side Panel per Section 5.04-A.
2. Disconnect the gas input hose from the inert B fitting input located on the right side of the Air Line Regulator Assembly.



3. Remove the four screws securing the Regulator to the Rear Panel.
4. Pull the Air Line Regulator away from the Rear Panel far enough to disconnect the plumbing joint between the Reducer and Elbow Fitting.
5. Remove the Regulator from the 2 inch brass nipple connected to the Solenoid Assembly.
6. Remove the elbow fitting from the old assembly.
7. Install the replacement Air Line Regulator Assembly by reversing the above procedure, keeping in mind the following:
   - Apply pipe thread sealant to the fitting before reassembling.

G. Filter/Voltage Divider PC Board Replacement

1. Remove the Right Side Panel per Section 5.04-A.
2. Disconnect the two wiring connectors at J23 and J24 from the Filter / Divider PC Board.
3. If CNC wiring is connected to TB1, then remove the TB1 from the PC Board. The terminal block is plugged into a socket on the Filter / Voltage Divider PC Board.
4. Install the replacement Filter / Voltage Divider PC Board making sure to reconnect any wiring removed.

SECTION 6:
PARTS LISTS

6.01 Introduction

A. Parts List Breakdown

The parts lists provide a breakdown of all replaceable components. Parts are organized as follows:

Section 6.03 Major External Replacement Parts

Section 6.04 Access Panel Replacement Parts

Section 6.05 Left Side Center Chassis Replacement Parts

Section 6.06 Right Side Center Chassis Replacement Parts

Section 6.07 Base Component Replacement Parts

Section 6.08 Rear Panel Replacement Parts

Section 6.09 Options and Accessories

NOTE

Parts listed without item numbers are not shown, but may be ordered by the catalog number shown.

B. Returns

If a product must be returned for service, contact your authorized distributor. Materials returned without proper authorization will not be accepted.

C. Product Improvements

Improvements to the product since release is denoted by a revision letter(s) located on the data tag of the unit. There are old style and new style data tags that may be encounted. The old style data tag has the revision letter(s) at the end of the serial number. The new style data tag has the revision letter(s) in an area marked 'Rev'. The parts lists may include references to the revision letter(s) for parts that are different between revisions.

6.02 Ordering Information

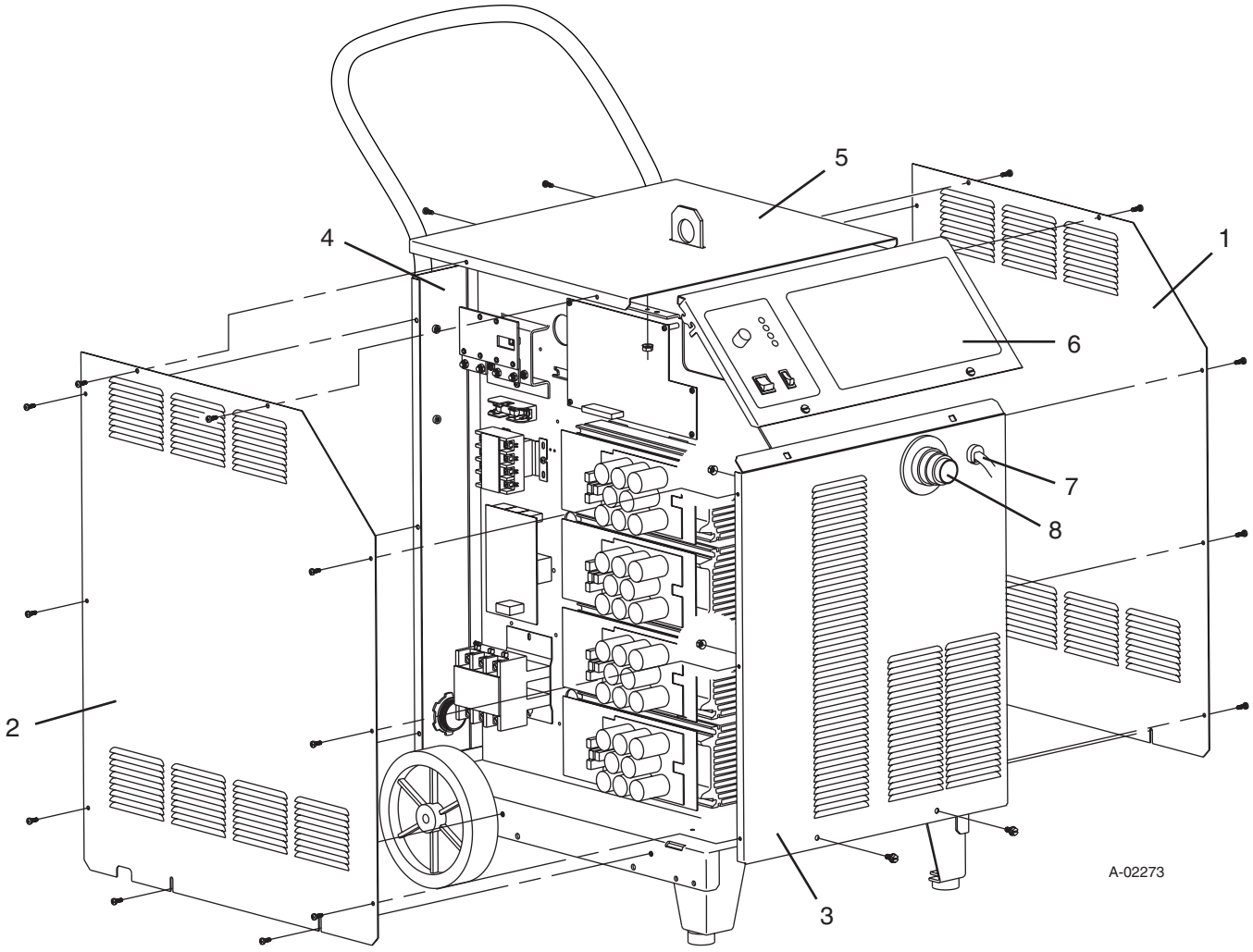
Order replacement parts by catalog number and complete description of the part or assembly, as listed in the parts list for each type item. Also include the model and serial number of the torch. Address all inquiries to your authorized distributor.

6.03 Major External Replacement Parts

Item #	Qty	Description	Catalog #
1	1	RIGHT PANEL W/LABELS	9-7819
2	1	LEFT SIDE PANEL W/LABELS	9-7818
3	1	FRONT PANEL W/LABELS	9-7816
4	1	REAR PANEL - Refer to Section 6.08 for Parts List	
5	1	TOP PANEL	9-7797
6	1	ACCESS PANEL - Refer to Section 6.04 for Parts List	
7	1	CABLE, WORK, 22' #4 AWG W/RING TERMINAL	9-7792
8	1	BOOT, RUBBER	9-4210

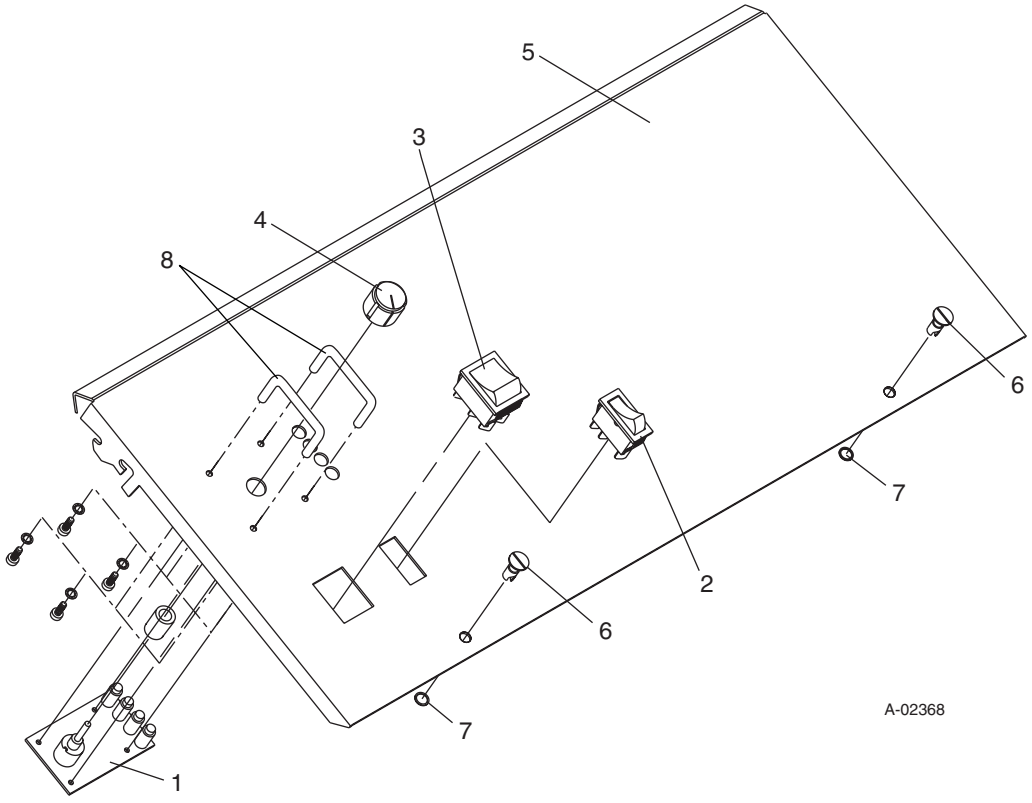
The following is not shown:

	1	Torch Coolant - 1 gal (3.78 liters)	
		Extra-Cool™ Coolant for Ambient Temperatures to +10°F (-12°C)	7-3580
		Ultra-Cool™ Coolant Ambient Temperatures to -27°F (-33°C)	7-3581



6.04 Access Panel Replacement Parts

Item #	Qty	Description	Ref #	Catalog #
1	1	ASS'Y, POT/LED PCB		9-8004
2	1	SWITCH, ROCKER, SPST	SW2	9-1042
3	1	ON/OFF ROCKER SWITCH, DPST	SW1	8-3258
4	1	KNOB, CURRENT CONTROL W/FOAM SEAL		9-8007
5	1	ASSEMBLY, ACCESS PANEL w/Overlay		9-7821
6	2	"DZUS" STUD		9-4346
7	2	"DZUS" RETAINING RING		9-4347
8	1	POT PROTECTION KIT includes:		7-7575
	2	Handles		
	2	Screws		
	2	Star Washers		

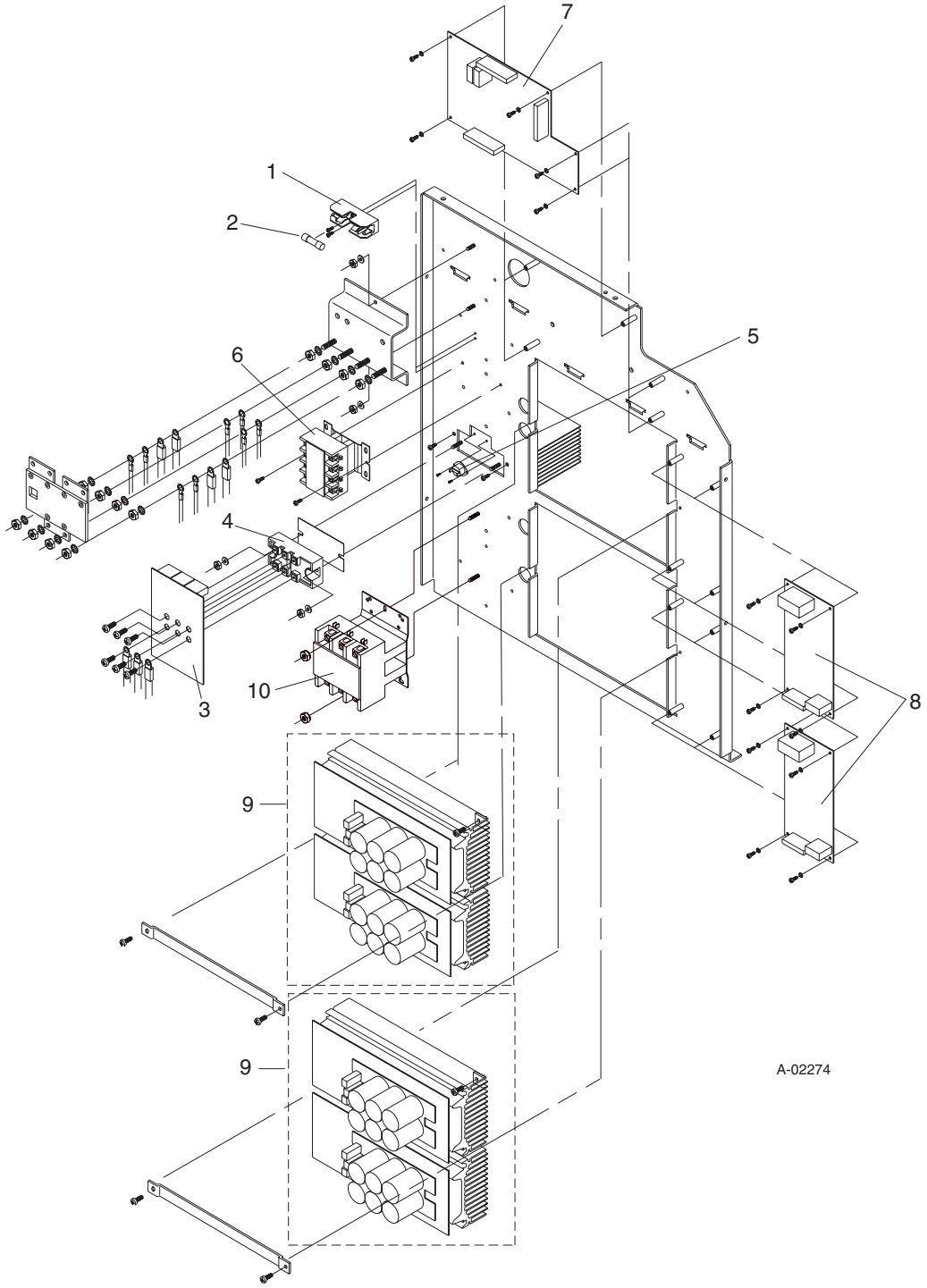


6.05 Left Side Center Chassis Replacement Parts

Item #	Qty	Description	Ref #	Catalog #
1	1	FUSE BLOCK,		9-5562
2	1	FUSE, 5 AMP, 600V, DELAY, FNQ-R-5	F1	10-2274
3	1	INPUT PCB ASSEMBLY		9-7813
4	1	ASSEMBLY BRIDGE RECTIFIER, 110A 3PH	BR1	9-7824
	1	BRIDGE RECTIFIER, 110A 3PH		9-7800
	1	THERMAL PAD, QIII, INPUT MODULE		
5	1	THERMOSTAT, CLOSES @ 80c RISING	TS2	9-7895
6	1	CONTACTOR, 4 POLE, 40 FLA, 120 VAC (In-Rush Contactor)	INR	9-7507
7	1	LOGIC PCB ASSEMBLY		9-7812
8	2	GATE DRIVE PCB		9-7811
9	1	FET / HEATSINK ASSEMBLY KIT, includes:		9-7015
	2	FET / HEATSINK ASSEMBLY		
10	1	MAIN CONTACTOR (Location on current units)	W	9-1244

The following parts are not shown:

	1	CABLE ASS'Y, 10 CIR RIBBON, 15"LG	9-5922
	1	CABLE, 3 CIRCUIT	9-7509
	1	CABLE ASSY 20 CIRCUIT RIBBON 20" LONG	9-7804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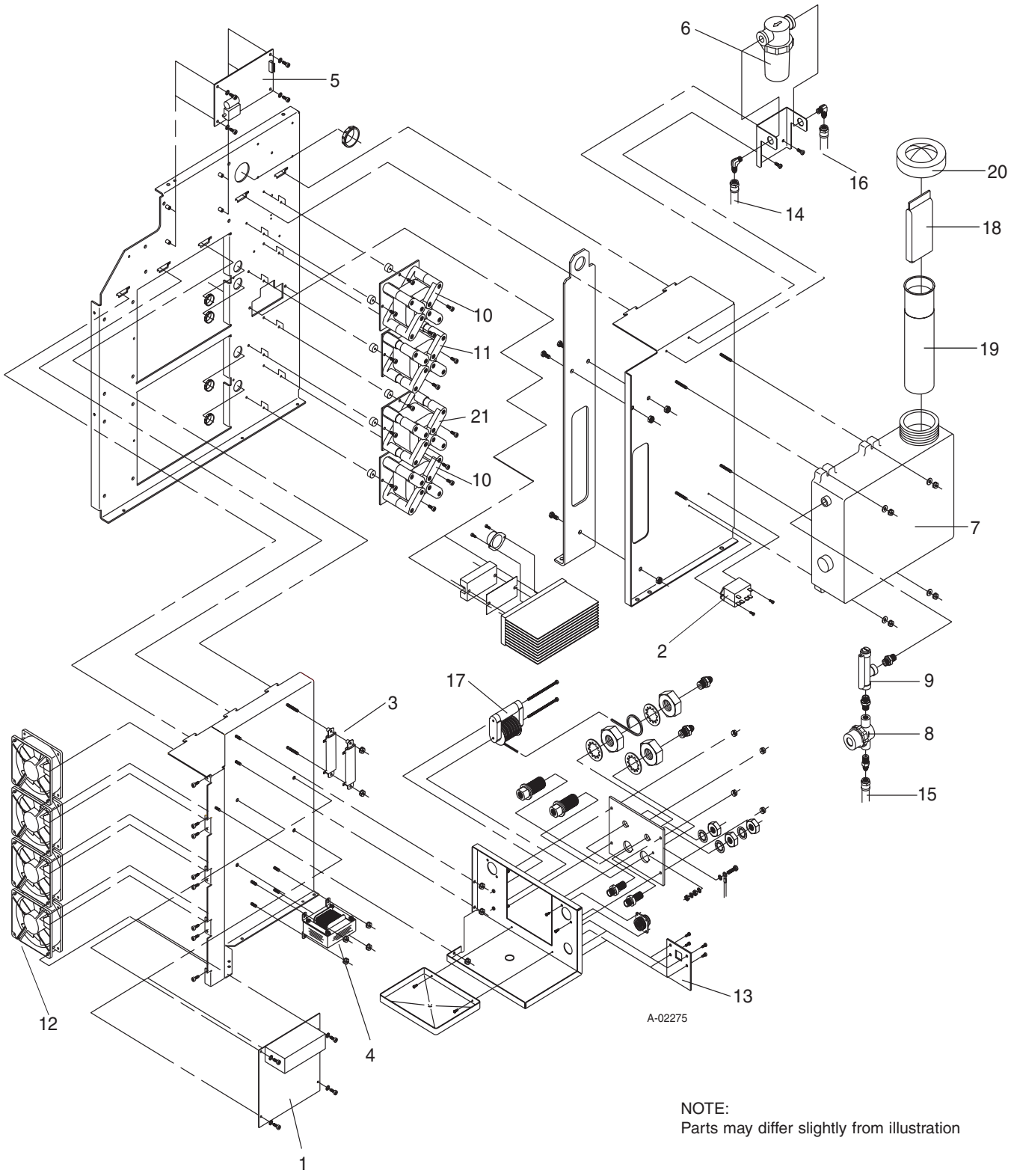
6.06 Right Side Center Chassis Replacement Parts

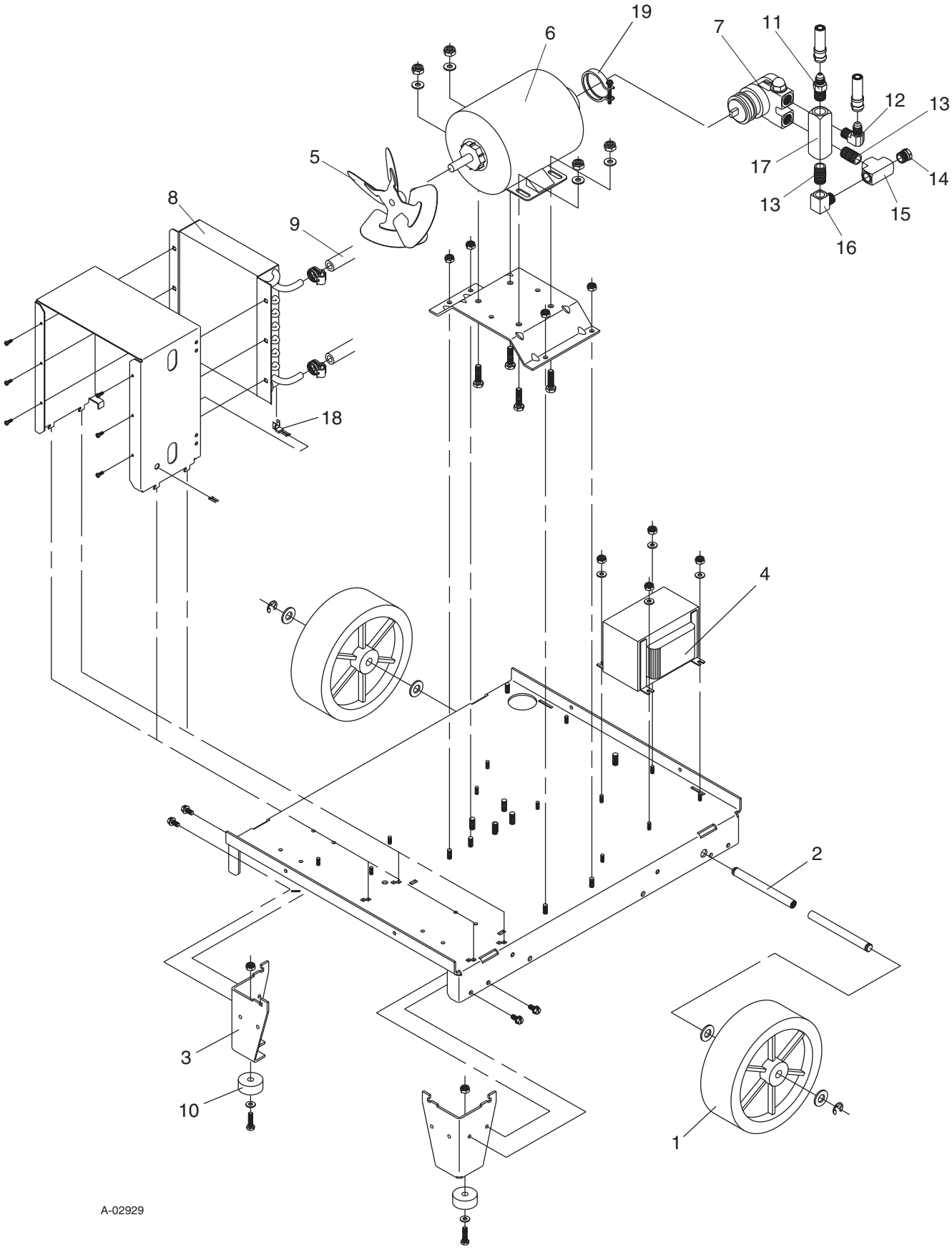
Item #	Qty	Description	Ref #	Catalog #
1	1	PILOT/OUTPUT PCB ASSEMBLY		9-7809
2	1	RELAY, DPST, 25A MAX, 120 AC (Coolant Motor Relay)	MC1	8-3390
3	2	RESISTOR	R1,R2	9-5843
4	1	INDUCTOR, PILOT	L3	9-7801
5	1	CD PCB ASSEMBLY		9-7814
6	1	COOLANT FILTER		8-4276
7	1	COOLANT RESERVOIR		9-5948
8	1	FILTER, IN-LINE, FEMALE		8-3460
9	1	FLOW SWITCH ASSEMBLY, 0.2 GPM	FS1	9-5937
10	2	MAIN TRANSFORMER	T1, T2	9-7810
11	1	OUTPUT INDUCTOR ASSEMBLY	L1	9-7815
12	4	FAN, 115V, 50/60Hz, 95/115CFM W/.187 TABS	M1-M4	8-3209
13	1	ASS'Y, CURRENT SENSE PCB		9-7602
14	1	HOSE, FILTER TO PUMP		9-7805
15	1	HOSE, RADIATOR TO SMALL FILTER		9-7807
16	1	HOSE, RESERVOIR TO FILTER		9-7808
17	1	ASSEMBLY, CD COIL	T4	9-7825
18	1	DEIONIZER BAG		8-3312
19	1	DEIONIZER BASKET		8-4410
20	1	CAP, COOLANT TANK		8-5142
21	1	OUTPUT INDUCTOR ASSEMBLY	L2	9-7872
Not Shown:				
	1	Field Update Kit (for Units before Rev AJ)		9-8651
	1	Shield Return Capacitor Assembly		
	1	Pilot Panel Ground Strap		



NOTE:
Parts may differ slightly from illustration

6.07 Base Replacement Parts

Item #	Qty	Description	Ref #	Catalog #
1	2	WHEEL	8-5579	
2	1	AXLE		9-7891
3	2	SUPPORT LEG		9-7892
4	1	TRANSFORMER,AUXILIARY (220,395,460)	T3	9-7802
	2	Fuse, 5A, 250V Delay MDL-5 (in Torch Spare Parts Kit)		9-8109
5	1	FAN, MEDIUM PRESSURE, 8" DIA.		9-7893
6	1	MOTOR, 1/3 HP, 1425/1725 RPM, 115/230 V, 50/60 HZ	M5	9-5932A
7	1	PUMP, ROTARY - VANE TYPE		9-6164
8	1	RADIATOR ASSY (INCLUDES 6 GROMMETS)		9-5941
9	1	HOSE, TORCH DISCONNECT TO RADIATOR		9-7806
10	2	FOOT, RUBBER, 1.50 DIA. X 0.63 HIGH		9-7894
11	3	#6 JIC - 3/8 NPT STR ADAPTER		8-0348
12	4	#6 JIC-3/8 NPT X 90 DEG ADAPTER		9-3077
13	2	3/8 NPT CLOSE NIPPLE		9-2384
14	1	3/8 NPT HEX HEAD PLUG		9-4583
15	1	3/8 NPT FEM TEE		9-2385
16	1	3/8 NPT STREET ELBOW		9-2365
17	1	VALVE, CHECK 3/8 NPT FEM, BRASS		9-1402
18	1	THERMAL SWITCH	TS1	9-5967
19	1	CLAMP, PUMP V-BRAND		9-5942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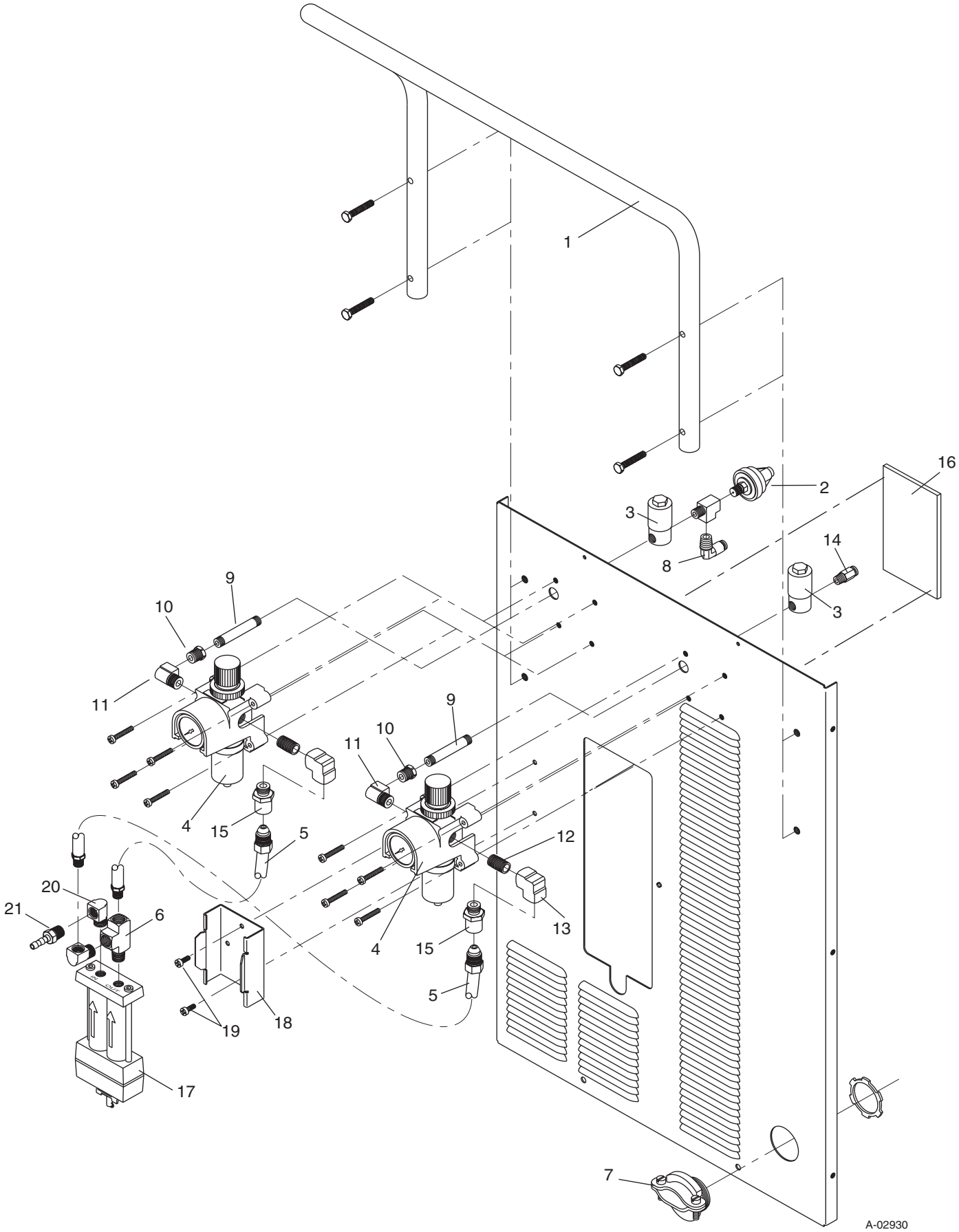
6.08 Rear Panel Replacement Parts

Item #	Qty	Description	Ref #	Catalog #
1	1	HANDLE (WITH SCREWS)		9-7822
2	1	PRESSURE SWITCH-35 PSI,	PS1	9-1044
3	2	VALVE, SOLENOID 1/8 NPT,	SOL1, SOL2	8-3370
4	2	AIR REGULATOR/FILTER ASSEMBLY		
		AIR LINE REGULATOR		9-7514
		PRESSURE GAUGE		9-1045
		PANEL MOUNTING NUT		9-5804
		BRACKET, REGULATOR MOUNTING		9-7589
5	2	HOSE		9-3743
6	1	1/4 NPT FEM TEET		9-2034
7	1	STRAIN RELIEF		9-3164
8	1	ONE TOUCH, 90 DEG, 1/8 NPT		9-2391
9	2	FITTING 1/8 NPT X 2' LONG NIPPLE, BRASS		9-7524
10	2	1/4-1/8 NPT REDUCER		9-2023
11	2	1/4 NPT STREET ELBOW		9-2184
12	2	NIPPLE, CLOSE, 1/4 NPT-1/4 NPT		9-2186
13	2	1/4 NPT FEM ELBOW		9-4595
14	1	FITTING 1/8 NPT X 1/4 TUBE STR		8-3360
15	2	FITTING, ADAPTER, 1/4NPT - INERT B, R.H.		8-0330
16	1	Filter/Voltage Divider PC Board		8-6465
17	1	FILTER, AIR, 2 STAGE		9-7527
	1	FIRST STAGE FILTER REPLACEMENT		9-1021
	1	SECOND STAGE FILTER REPLACEMENT		9-1022
18	1	BRKT, FILTER MOUNTING		9-7535
19	2	#10-32 x 1-1/8" PPH Screw		See Note
20	1	1/4 NPT STREET ELBOW		9-2184
21	1	Adapter Fitting, Barb		8-4264

NOTE: Part can be purchased locally.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6.09 Options and Accessories

Qty	Description	Catalog #
1	575V Transformer Module	9-7700
	Primary Input Power Cable, 10 ft. (3.05 m)	
1	230VAC, 2AWG, 4 COND, 600V	9-7697
1	460VAC, 6AWG, 4 COND, 600V	9-7696
1	"Y" Hose Assembly Kit	9-7827
1	Locking Caster Kit (2 Casters)	9-7868
1	Remote Pendant Control, 20 ft (6.1 m)	7-3460

APPENDIX 1: INPUT WIRING REQUIREMENTS

Input		Power Input	Current	Suggested Sizes (See Notes)		
Voltage (Volts)	Freq. (Hz)	3-Ph (kVA)	3-Ph (Amps)	Fuse (Amps) 3-Ph	Wire (AWG) 3-Ph	Wire (Canada) 3-Ph
208	50/60	28.1	78	100	2	2
220	50/60	28.6	75	100	2	2
230	50/60	29.5	74	100	2	2
240	50/60	29.9	72	90	2	2
380	50/60	29.0	44	60	6	6
415	50/60	29.5	41	60	6	6
460	50/60	29.5	37	50	6	6
575	Requires Transformer Module					

Line Voltages with Suggested Circuit Protection and Wire Sizes
Based on National Electric Code and Canadian Electrical Code

NOTES

Refer to Local and National Codes or local authority having jurisdiction for proper wiring requirements.

Cable size is de-rated based on the Duty Cycle of the equipment.

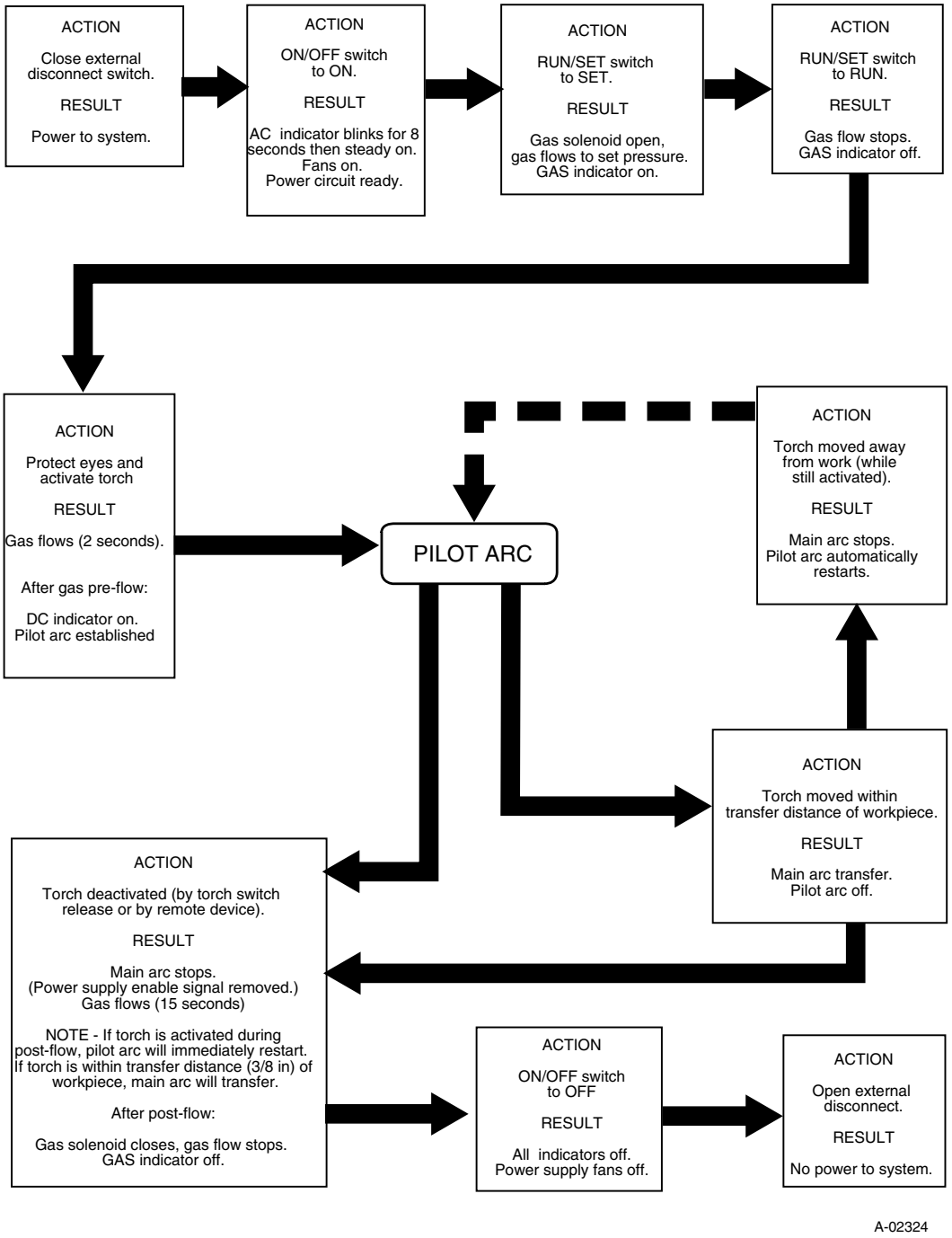
The suggested sizes are based on flexible power cable with power plug installations. For hard-wired installations refer to local or national codes.

Cable conductor temperature used is 167° F (75° C).

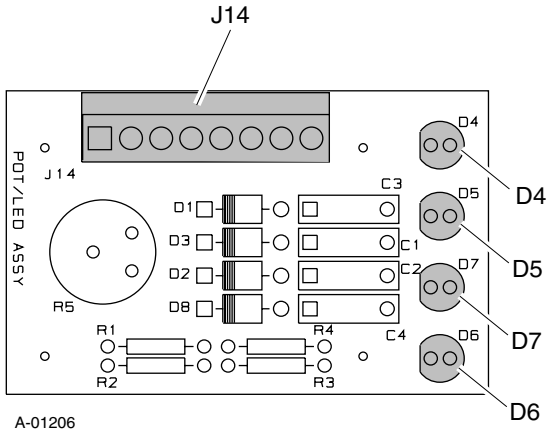
An energy limiting fuse UL Class RK-1 (examples: BUSS LPS/LPN-RK or Gould-Shawmut AZK-A6K) should be used to minimize damage to Plasma Cutting, Welding or power distribution equipment.

***NEVER** use replaceable element fuses like UL Class H, or "one-time" fuses like UL Class K5.*

APPENDIX 2: SEQUENCE OF OPERATION (BLOCK DIAGRAM)



APPENDIX 3: POT/LED PC BOARD LAYOUT

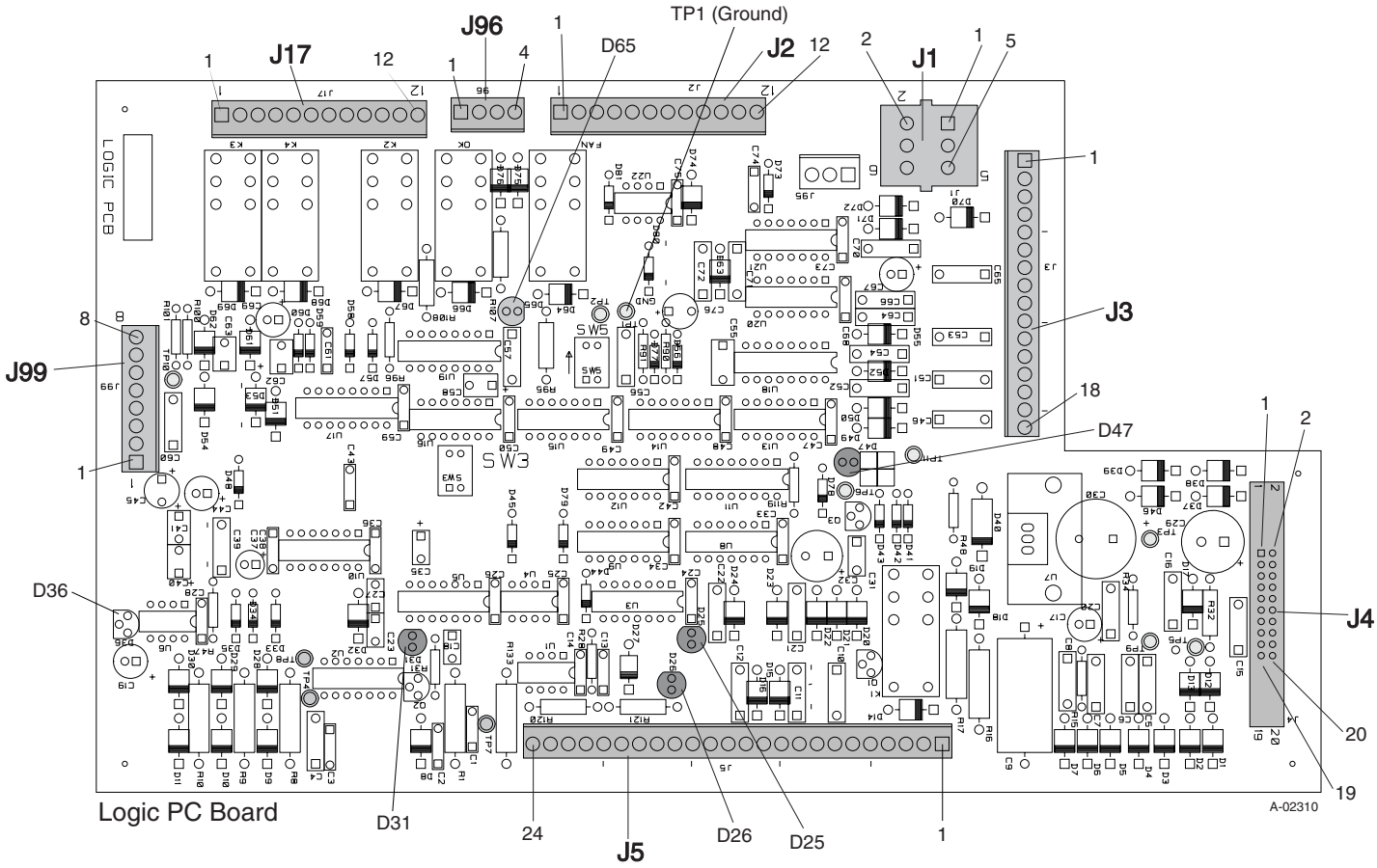


Pot/LED PC Board Signals

J14-1 +10 vdc from Logic PC Board (J3-7) - Potentiometer High
J14-2 Current Control to Logic PC Board (J3-8) - Potentiometer Wiper
J14-3 Return for Current Control from Logic PC Board (J3-9) - Potentiometer Low
J14-4 +12 vdc from Logic PC Board (J3-10)
J14-5 Signal for AC OK Indicator to Logic PC Board (J3-11)
J14-6 Signal for GAS Indicator to Logic PC Board (J3-12)
J14-7 Signal for TEMP Indicator to Logic PC Board (J3-13)
J14-8 Signal for DC Indicator to Logic PC Board (J3-14)

D4 Front Panel AC Indicator
D5 Front Panel TEMP Indicator
D6 Front Panel DC Indicator
D7 Front Panel GAS Indicator

APPENDIX 4: LOGIC PC BOARD LAYOUT



Logic PC Board Signals

J1-1 36 VAC from Auxiliary Transformer
J1-2 115 VAC from Auxiliary Transformer
J1-3 Center Tap from Auxiliary Transformer
J1-4 Not Used
J1-5 36 VAC from Auxiliary Transformer
J1-6 115 VAC Return from Auxiliary Transformer

J2-1 115 VAC Return to Main Contactor
J2-2 115 VAC Return to Plasma Solenoid
J2-3 Not Used
J2-4 115 VAC to Main Contactor
J2-5 Not Used
J2-6 115 VAC to Secondary Solenoid
J2-7 Not Used
J2-8 Not Used
J2-9 Pressure Switch +12 vdc Signal
J2-10 Pressure Switch Return
J2-11 Over Temp Sw. (Input Bridge, Pilot Bd, Radiator) 12V
J2-12 Over Temp Sw. (Input Bridge, Pilot Bd, Radiator) Return
J2-13 Not Used
J2-14 Not Used
J2-15 Not Used
J2-16 Not Used

J3-1 36 VAC to ON/OFF Switch
J3-2 36 VAC from ON/OFF Switch
J3-3 36 VAC to ON/OFF Switch
J3-4 36 VAC from ON/OFF Switch
J3-5 RUN/SET Switch on Front Panel +12V signal
J3-6 RUN/SET Switch on Front Panel Return
J3-7 Main Current Control Signal (High) +10 vdc
J3-8 Main Current Control Pot (Wiper)
J3-9 Main Current Control Pot (Low)

J3-10 +12 vdc
J3-11 Active Low Signal for AC Indicator on Front Panel (J14-5)
J3-12 Active Low Signal for GAS Indicator on Front Panel (J14-6)
J3-13 Active Low Signal for TEMP Indicator on Front Panel (J14-7)
J3-14 Active Low Signal for DC Indicator on Front Panel (J14-8)
J3-15 Not Used
J3-16 Not Used

J4-1 36 VAC (b) from Gate Driver PC Board (J9-1)
J4-2 36 VAC (a) to Gate Drive PC Board (J9-2)
J4-3 36 VAC (a) from Gate Drive PC Board (J9-3)
J4-4 36 VAC (b) to Gate Drive PC Board (J9-4)
J4-5 36 VAC CT Return/PC Board Common
J4-6 Transfer Mod Enable Return
J4-7 36 VAC CT Return/PC Board Common
J4-8 Active Low Transfer Mod Enable Signal
J4-9 Return for Temp Switch
J4-10 Active Low Over Temp Signal
J4-11 Return for Master Enable Signal
J4-12 Active Low Master Enable Signal
J4-13 Return for Pilot Enable
J4-14 Active Low Pilot Enable Signal
J4-15 Return for PSR Signal
J4-16 Active Low PSR Signal
J4-17 Return for Demand Signal
J4-18 Demand Signal
J4-19 Return for Demand Signal

J5-1 36 VAC (b) to CD PC Board
J5-2 36 VAC CT Return to CD PC Board
J5-3 36 VAC (a) to CD PC Board
J5-4 Active Low CD Enable Signal
J5-5 CD Enable Return
J5-6 Active Low Pilot Signal to Pilot/Output Board
J5-7 Pilot Signal Return
J5-8 Active Low Torch Switch Signal
J5-9 Torch Switch Return
J5-10 Not Used - Wire to J28-1
J5-11 Not Used
J5-12 PS+
J5-13 Not Used
J5-14 Drag Sensing Signal Voltage (Tip Volts +)
J5-15 Not Used
J5-16 PS-
J5-17 36 VAC (a) to Pilot Output Board
J5-18 36 VAC (b) to Pilot Output Board
J5-19 36 VAC CT Return to Pilot/Output Board (Opt Remote)
J5-20 Active Low ENABLE Signal
J5-21 Return for Optional Remote Enable Jumper

J95-1 Not Used
J95-2 Not Used

J96-1 115VAC to Fans M3 & M4
J96-2 115VAC to Fans M1 & M2
J96-3 115VAC Fan Rtn for M3 & M4
J96-4 115VAC Fan Rtn for M1 & M2

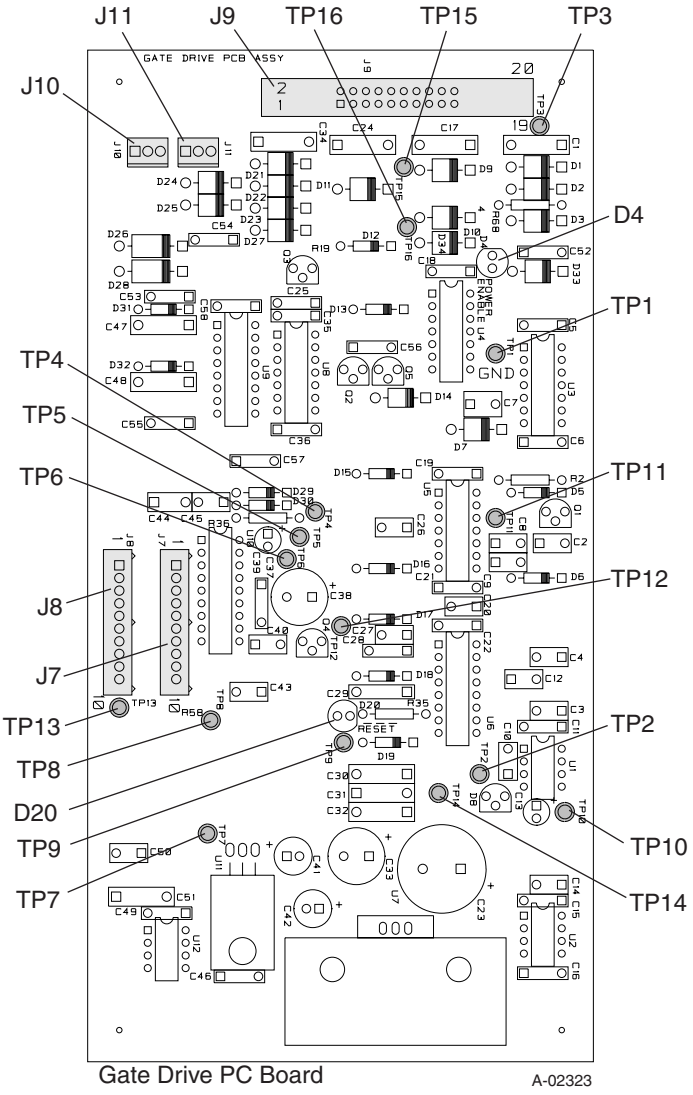
J17-1 Not Used
J17-2 Not Used
J17-3 115 VAC to Plasma Solenoid
J17-4 115 VAC to Inrush Cont
J17-5 115 VAC to Motor Cont
J17-6 Not Used
J17-7 115 VAC Return Sec. Solenoid
J17-8 115 VAC Return Inrush Cont
J17-9 115 VAC Return Motor Cont
J17-10 Not Used
J17-11 OK-To-Move (Isolated Contact Closure)
J17-12 OK-To-Move (Isolated Contact Closure)

J99-1 Active Low Coolant Flow Switch Signal
J99-2 Not Used
J99-3 Coolant Flow Switch Return
J99-4 Not Used
J99-5 Not Used - Wire from J28-3
J99-6 Active Low CSR Signal From Current Sense Board
J99-7 Return
J99-8 +12 vdc

TP1 Logic Ground
TP2 +18 vdc - Unregulated
TP3 +18 vdc - Unregulated
TP4 +10 vdc
TP5 Demand Signal to Gate PC Board
TP6 +12 vdc
TP7 Drag CRT
TP8 (-) DC Sense
TP9 Active Low PSR Signal
TP10 Active Low CSR Signal
TP11 Current Control Demand (Pot Wiper)

D26 Torch Switch Enable Indicator
D25 CD Enable Indicator
D65 CSR Indicator
D47 AC OK Indicator
D31 Drag On Indicator

APPENDIX 5: GATE DRIVE PC BOARD LAYOUT



Gate Drive PC Board

Gate Drive PC Board Signals

J7-1 +12 vdc to FET PC Boards (J6-1)
J7-2 Return for +12 vdc to FET PC Boards (J6-2)
J7-3 PWM Output (A) to FET PC Boards (J6-3)
J7-4 PWM Return to FET PC Boards (J6-4)
J7-5 Primary Current Sense from FET PC Boards (J6-5)
J7-6 Primary Current Sense Return from FET PC Boards (J6-6)
J7-7 Secondary Current Sense from FET PC Boards (J6-7)
J7-8 Secondary Current Sense Return from FET PC Boards (J6-8)
J7-9 Over Temperature Sense from FET PC Boards (J6-9)
J7-10 Over Temperature Sense from FET PC Boards (J6-10)

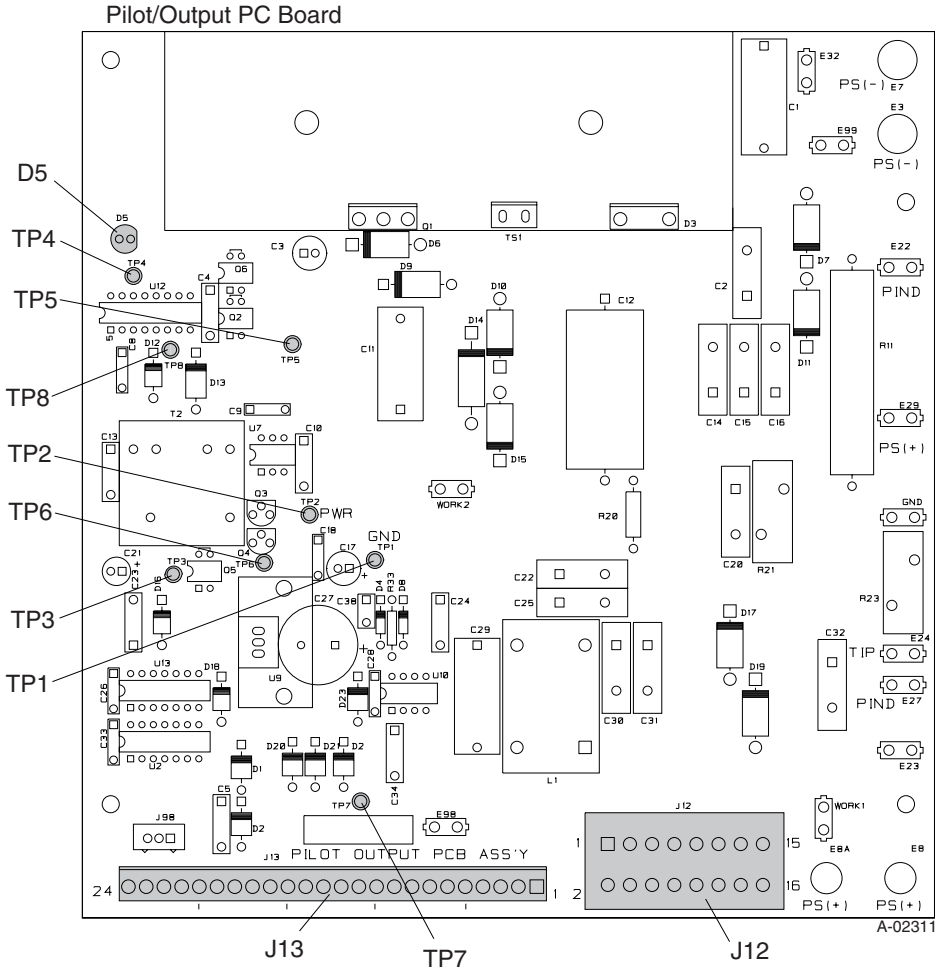
J8-1 +12 vdc to FET PC Boards (J6-1)
J8-2 Return for +12 vdc to FET PC Boards (J6-2)
J8-3 PWM Output (B) to FET PC Boards (J6-3)
J8-4 PWM Return to FET PC Boards (J6-4)
J8-5 Primary Current Sense from FET PC Boards (J6-5)
J8-6 Primary Current Sense Return from FET PC Boards (J6-6)
J8-7 Secondary Current Sense from FET PC Boards (J6-7)
J8-8 Secondary Current Sense Return from FET PC Boards (J6-8)
J8-9 Over Temperature Sense from FET PC Boards (J6-9)
J8-10 Over Temperature Sense from FET PC Boards (J6-10)

J9-1 36 VAC (b) from Logic PC Board (J4-1)
J9-2 36 VAC (a) from Logic PC Board (J4-2)
J9-3 36 VAC (a) from Logic PC Board (J4-3)
J9-4 36 VAC (b) from Logic PC Board (J4-4)
J9-5 36 VAC CT Return from Logic PC Board (J4-5)
J9-6 Return for Transfer Mod Enable
J9-7 36 VAC CT Return from Logic PC Board (J4-7)
J9-8 Active Low Transfer Mod Enable Signal
J9-9 Active Low Over Temperature Sense from FET PC Boards to Logic PC Board (J4-9)
J9-10 Over Temperature Sense from FET PC Boards to Logic PC Board (J4-10)
J9-11 Return for Master Enable Signal to Logic PC Board (J4-11)
J9-12 Active Low Master Enable Signal from Logic PC Board (J4-12)
J9-13 Return for Pilot Enable Signal to Logic PC Board (J4-13)
J9-14 Active Low Pilot Enable Signal from Logic PC Board (J4-14)
J9-15 Return for PSR Signal from Logic PC Board (J4-15)
J9-16 Active Low PSR Signal to Logic PC Board (J4-16)
J9-17 Return for Demand Signal to Logic PC Board (J4-17)
J9-18 Demand Signal from Logic PC Board (J4-18)
J9-19 Return for Demand Signal from Logic PC Board (J4-19)
J9-20 Not Used

TP1 Logic Ground
TP2 +12 vdc
TP3 Active Low Transfer Mod Enable Signal
TP4 +5 vdc
TP5 PWM Signal (B)
TP6 PWM Signal (A)
TP7 Secondary Current Sense
TP8 Primary Current Sense
TP9 Active Low Reset Signal
TP10 +6 vdc
TP11 Current Demand Signal
TP12 Active Low Shutdown Signal
TP13 Return for Secondary Current Sense
TP14 -12 vdc
TP15 Active Low Pilot Enable Signal
TP16 Active Low Master Enable Signal

D4 Power Enable Indicator
D20 Reset Indicator

APPENDIX 6: PILOT/OUTPUT PC BOARD LAYOUT AND WIRING CONNECTION DIAGRAM

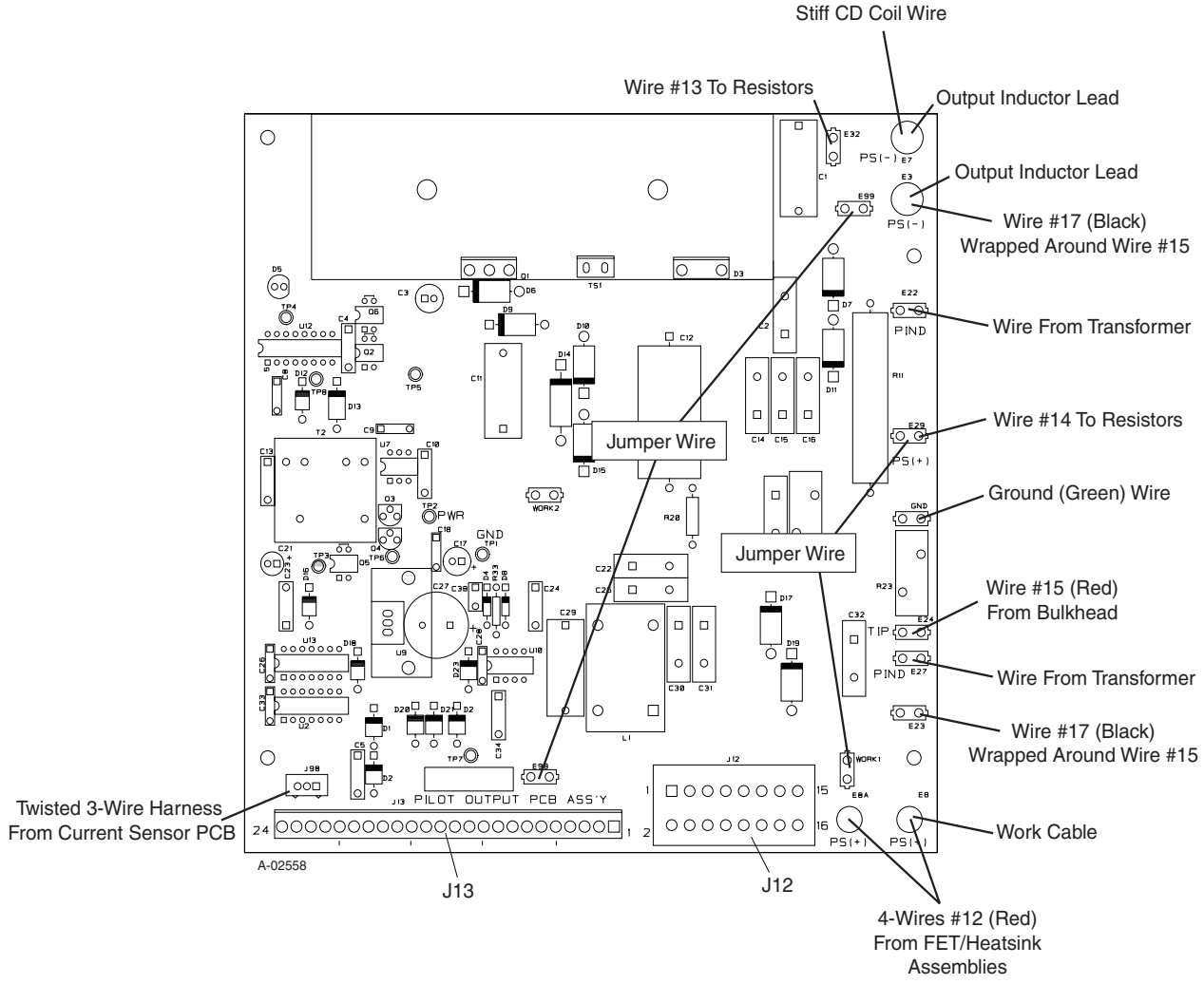


Pilot Output PC Board Signals

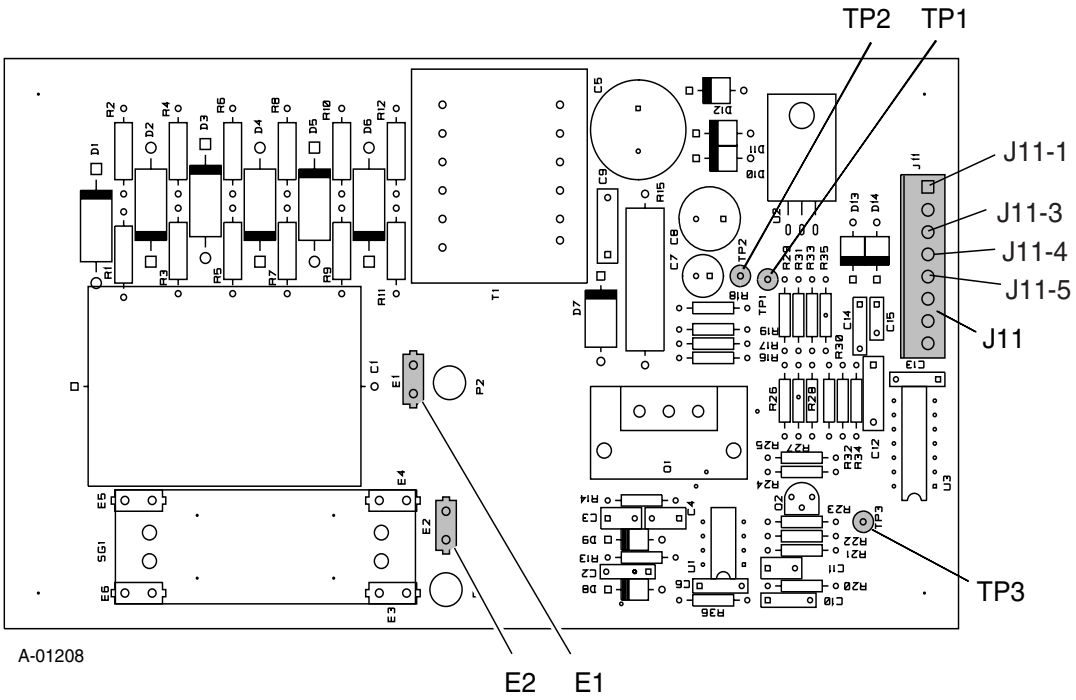
J12-1 START Signal from J23-8 Filter/Divider PC Board
J12-2 Shield to J26-1
J12-3 START Signal from J23-9 Filter/Divider PC Board
J12-4 Shield to J26-2
J12-5 Not Used
J12-6 Not Used
J12-7 OK-To-Move To J23-14 (Isolated Contacts from Logic PC Board)
J12-8 OK-To-Move To J23-16 (Isolated Contacts from Logic PC Board)
J12-9 Enable Jumper
J12-10 Not Used
J12-11 Enable Jumper
J12-12 Not Used
J12-13 Not Used
J12-14 Return to J23-11
J12-15 Not Used
J12-16 Return to J23-4

J13-1	Active Low START signal
J13-2	START Signal Return
J13-3	OK-To-Move (Isolated Contacts from Logic PC Board)
J13-4	OK-To-Move (Isolated Contacts from Logic PC Board)
J13-5	Ground
J13-6	Not Used
J13-7	Drag Voltage Sensing (Tip Voltage)
J13-8	Not Used
J13-9	PS(-) Voltage Sensing
J13-10	Not Used
J13-11	Enable Jumper
J13-12	Enable Jumper
J13-13	Not Used
J13-14	36 VAC (a) from Logic PC Board
J13-15	36 VAC (b) from Logic PC Board
J13-16	36 VAC CT Common
J13-17	Return for Pilot Signal
J13-18	Active Low Pilot Signal
J13-19	Not Used
J13-20	Active Low Overtemp Signal
J13-21	Return for Overtemp Signal
J13-22	Active Low CSR Sense Signal J98-1
J13-23	Return for CSR Sense Signal J98-2
J13-24	+12 vdc to Current Sense Board J98-3

TP1	Ground
TP2	+15 vdc
TP3	Pilot Switch to Gate Drive PC Board
TP4	Pilot Drive Signal
TP5	Not Used
TP6	Active Low Pilot Drive Signal
TP7	Not Used
TP8	Pilot Switch to Gate Drive PC Board
D5	Pilot ON Indicator



APPENDIX 7: CD PC BOARD LAYOUT



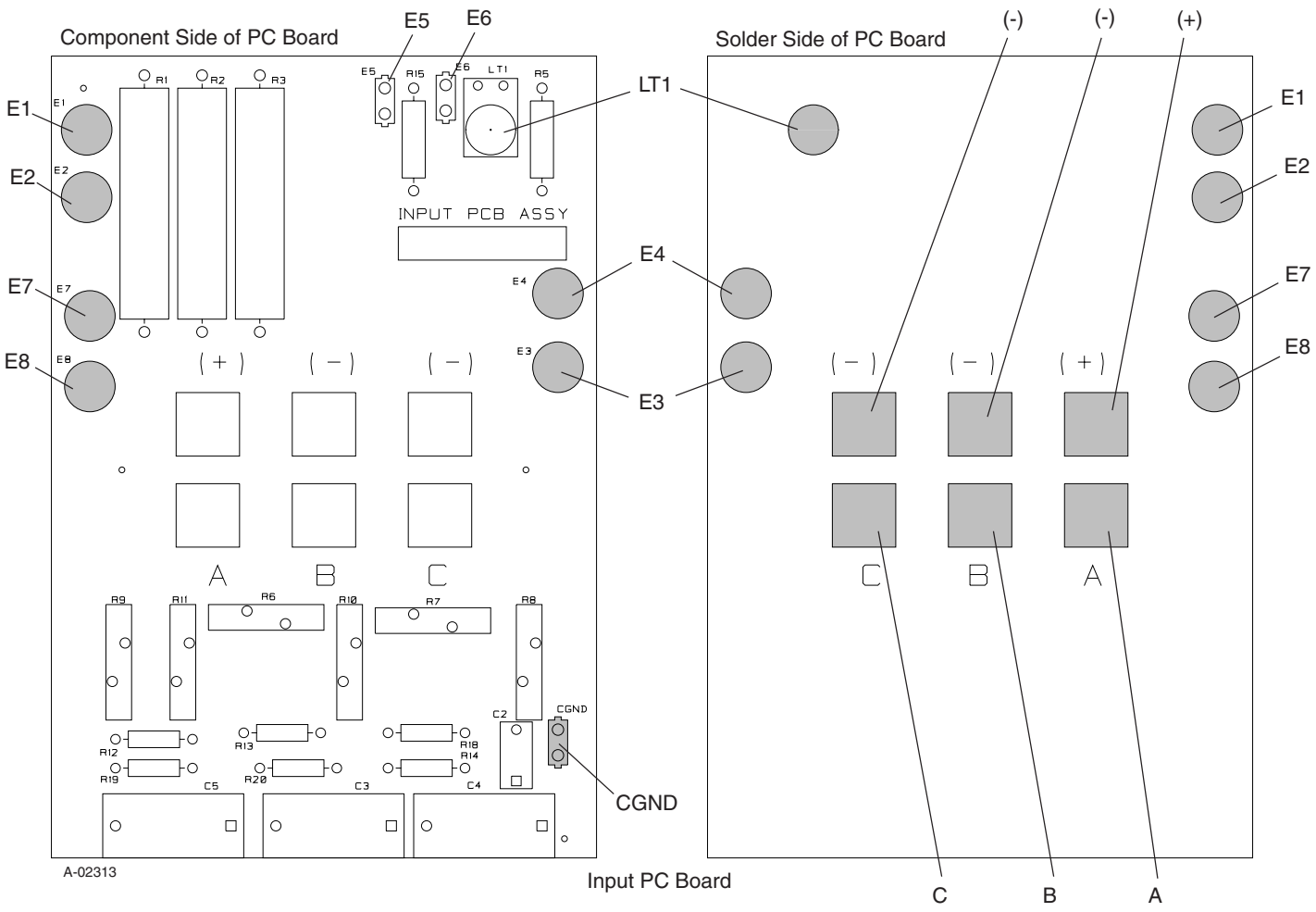
CD PC Board Signals

J11-1 36 VAC (b) from Logic PC Board (J5-1)
J11-2 36 VAC CT Return (J5-2)
J11-3 36 VAC (a) from Logic PC Board (J5-3)
J11-4 Active Low CD Enable Signal from Logic PC Board (J5-4)
J11-5 Return for CD Enable Signal from Logic PC Board (J5-5)
J11-6 Not Used
J11-7 Not Used
J11-8 Not Used

TP1 Logic Ground or Return
TP2 +12 vdc
TP3 Not Used

E1 CD output
E2 CD Output

APPENDIX 8: INPUT PC BOARD LAYOUT

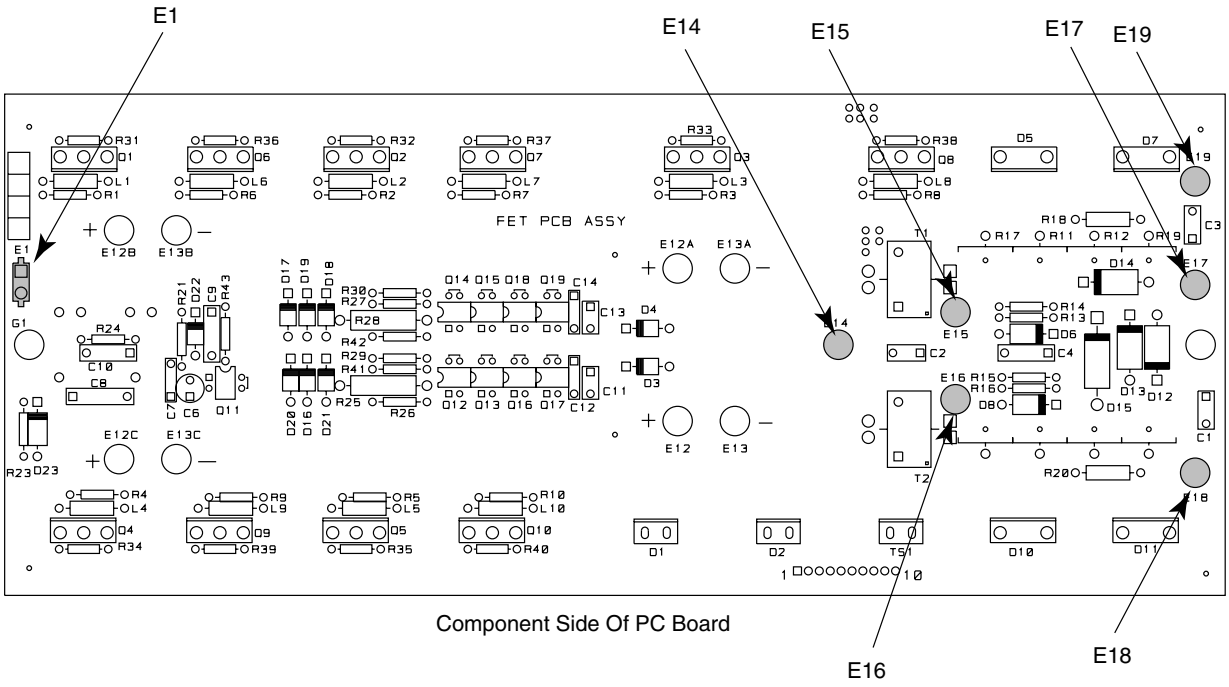


A AC Input (L1)
B AC Input (L2)
C AC Input (L3)
(-) Rectifier (-) Output
(-) Rectifier (-) Output
(+) Rectifier (+) Output
LT1 Power ON Indicator

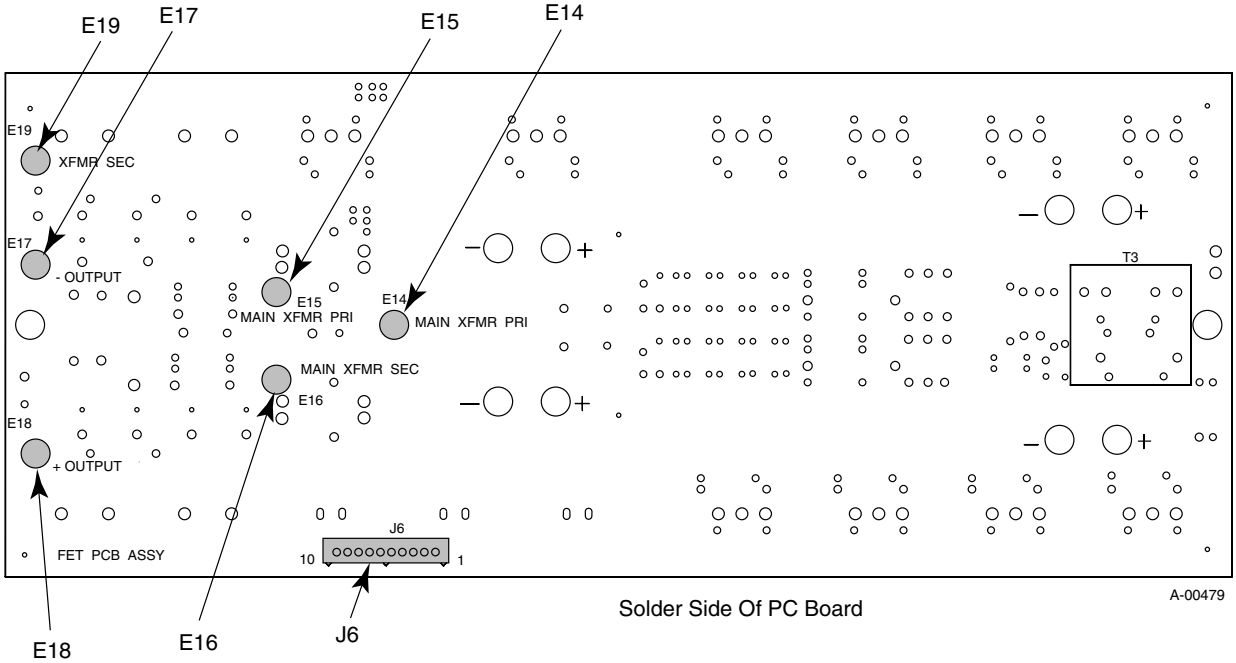
E1 Rectifier (+) Output to INR
E2 Rectifier (+) Output to INR
E3 Rectifier (-) Output to Capacitor PC Boards (A & C) and Input Voltage Selection
E4 Rectifier (-) Output to Capacitor PC Boards (A & C) and Input Voltage Selection
E5 AC Input (L1) for LT1
E6 AC Input (L2) for LT1
E7 Rectifier (+) from INR
E8 Rectifier (+) to Capacitor PC Boards (B & D) and Input Voltage Selection

CGND Chassis Ground

APPENDIX 9: FET PC BOARD LAYOUT



Component Side Of PC Board



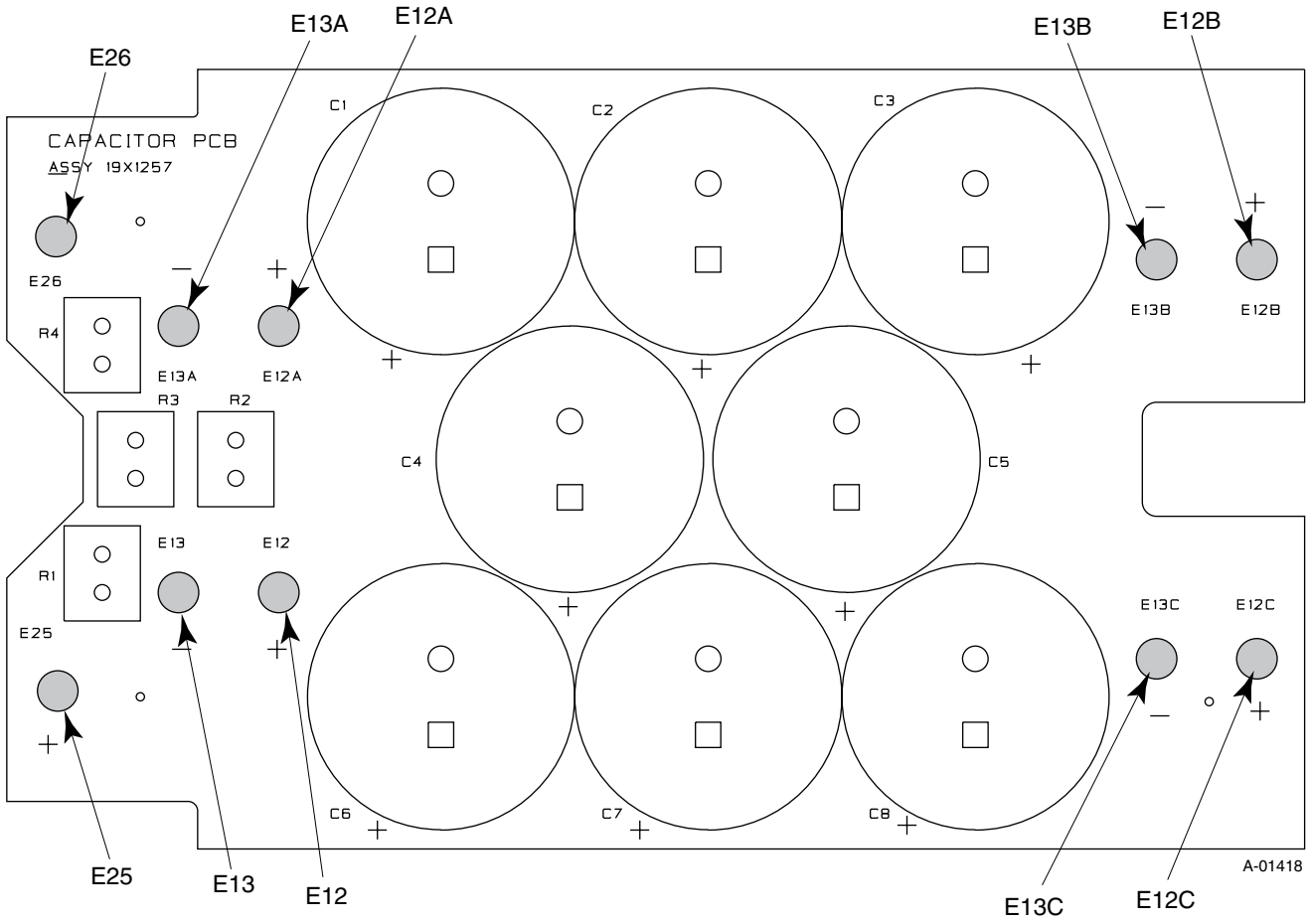
Solder Side Of PC Board

FET PC Board Signals (Upper and Lower Assemblies)

J6-1 +12 vdc from the Gate Drive Board upper J7-1 Lower J8-1
J6-2 +12 vdc RTN from the Gate Drive Board upper J7-2 Lower J8-2
J6-3 PWM Output from the Gate Drive Board upper J7-3 Lower J8-3
J6-4 PWM Output RTN J6-2 from the Gate Drive Board upper J7-4 Lower J8-4
J6-5 PRI CURRENT SENSE to the Gate Drive Board upper J7-5 Lower J8-5
J6-6 PRI CURRENT SENSE RTN to the Gate Drive Board upper J7-6 Lower J8-6
J6-7 SEC CURRENT SENSE to the Gate Drive Board upper J7-7 Lower J8-7
J6-8 SEC CURRENT SENSE RTN to the Gate Drive Board upper J7-8 Lower J8-8
J6-9 OVER TEMP RTN to the Gate Drive Board upper J7-9 Lower J8-9
J6-10 Active Low OVER TEMP Signal to the Gate Drive Board upper J7-10 Lower J8-10

E1 HEATSINK GND To HEAT SINK
E14 MAIN XFMR PRI to MAIN XFMR PRI E14
E15 MAIN XFMR PRI to MAIN XFMR PRI E15
E16 MAIN XFMR SEC from MAIN XFMR SEC E16
E17 OUTPUT (-) to OUTPUT INDUCTOR L1
E18 OUTPUT (+) to Current Sense Transformer and E8 on Output Board
E19 MAIN XFMR SEC from MAIN XFMR SEC E19

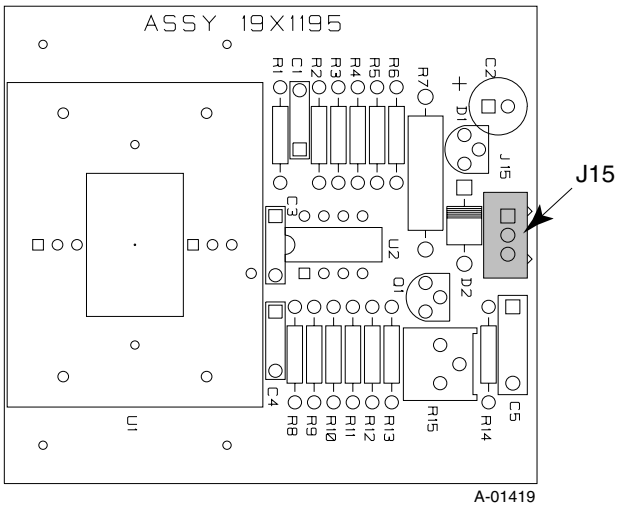
APPENDIX 10: CAPACITOR PC BOARD LAYOUT



Capacitor PC Board Signals

E12 Positve Rail to FET Board
E12A Positve Rail to FET Board
E12B Positve Rail to FET Board
E12C Positve Rail to FET Board
E13 Negative Rail to FET Board
E13A Negative Rail to FET Board
E13B Negative Rail to FET Board
E13C Negative Rail to FET Board
E25 Positive Input from E8 on Input PC Board
E26 Negative Input from E3 & E4 Input PC Board

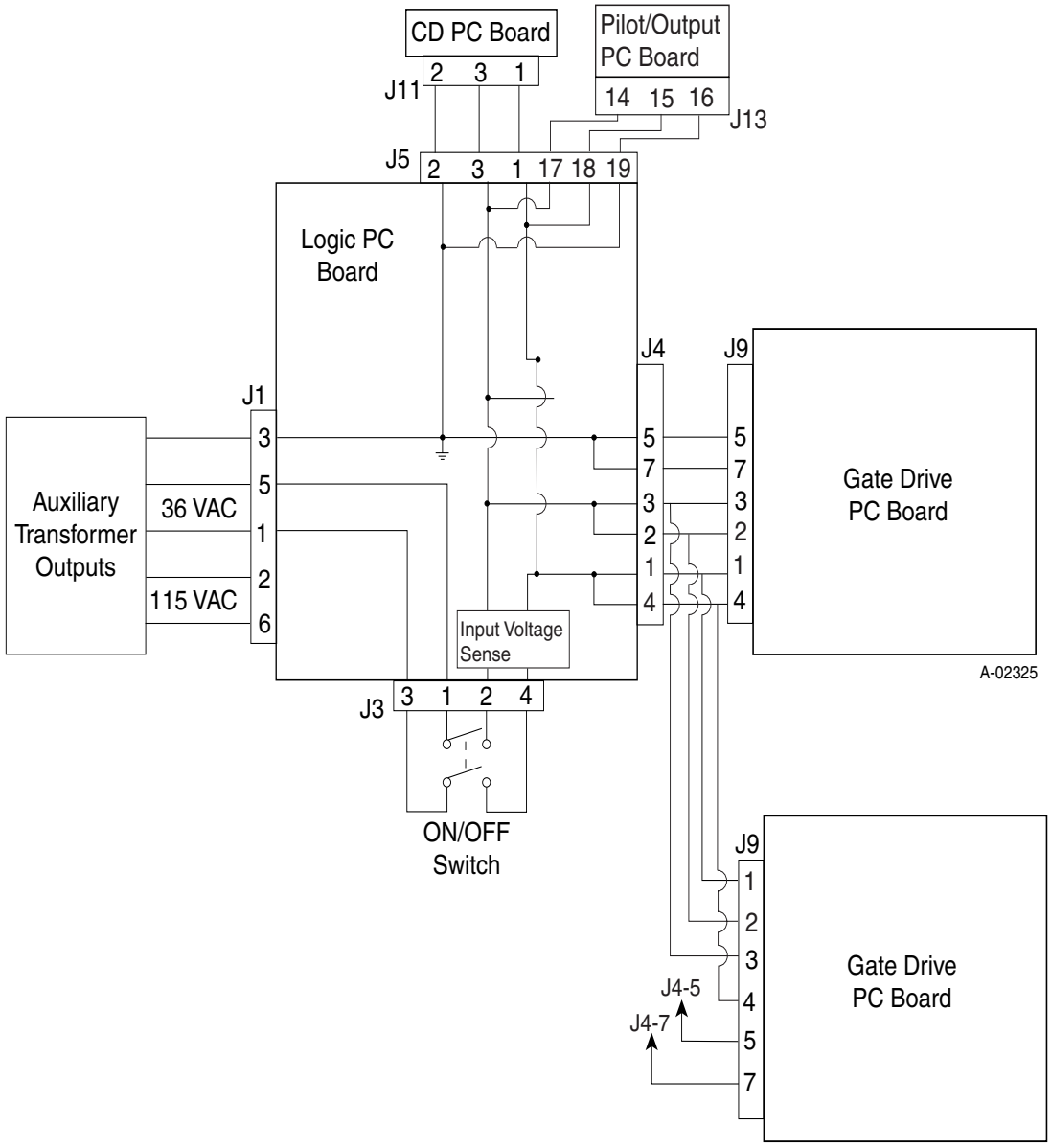
APPENDIX 11: CURRENT SENSOR PC BOARD LAYOUT



Current Sensor PC Board Signals

J15-1 Active Low CSR Sense Signal
J15-2 Ground
J15-3 +12 vdc

APPENDIX 12: 36VAC CIRCUIT DIAGRAM



APPENDIX 13: RECOMMENDED ROUTINE MAINTENANCE SCHEDULE FOR LIQUID COOLED PLASMA CUTTING SYSTEMS

This schedule applies to all types of liquid cooled plasma cutting systems. Some systems will not have all the parts listed and those checks need not be performed.

NOTE

The actual frequency of maintenance may need to be adjusted according to the operating environment.

Daily Operational Checks or Every Six Arc Hours:

1. Check torch parts, replace if damaged.
2. Check plasma and secondary supply and pressure/flow.
3. Purge plasma gas line to remove any moisture build-up.
4. Check deionizer bag/cartridge, replace if color is predominantly yellow.
5. Check coolant pressure (100 - 120 psi).

Weekly or Every 30 Arc Hours:

1. Check fan for proper operation and adequate air flow.
2. Blow or vacuum dust and dirt out of the entire machine.

CAUTION

Do not blow air into the power supply during cleaning. Blowing air into the unit can cause metal particles to interfere with sensitive electrical components and cause damage to the unit.

Six Months or Every 720 Arc Hours:

1. Remove and clean in-line filter screens.
2. Check cables and hoses for leaks or cracks, replace if necessary.
3. Check all contactor points for severe arcing or pits, replace if necessary.
4. Check all pillow blocks and bearings, clean and lubricate if necessary.
5. Check fan, pump and pulley belts for wear or cracking, replace if necessary.

Twelve Months or Every 1500 Arc Hours:

1. Drain coolant, fill with distilled water, turn on main power switch and let machine run for approximately 30 minutes.

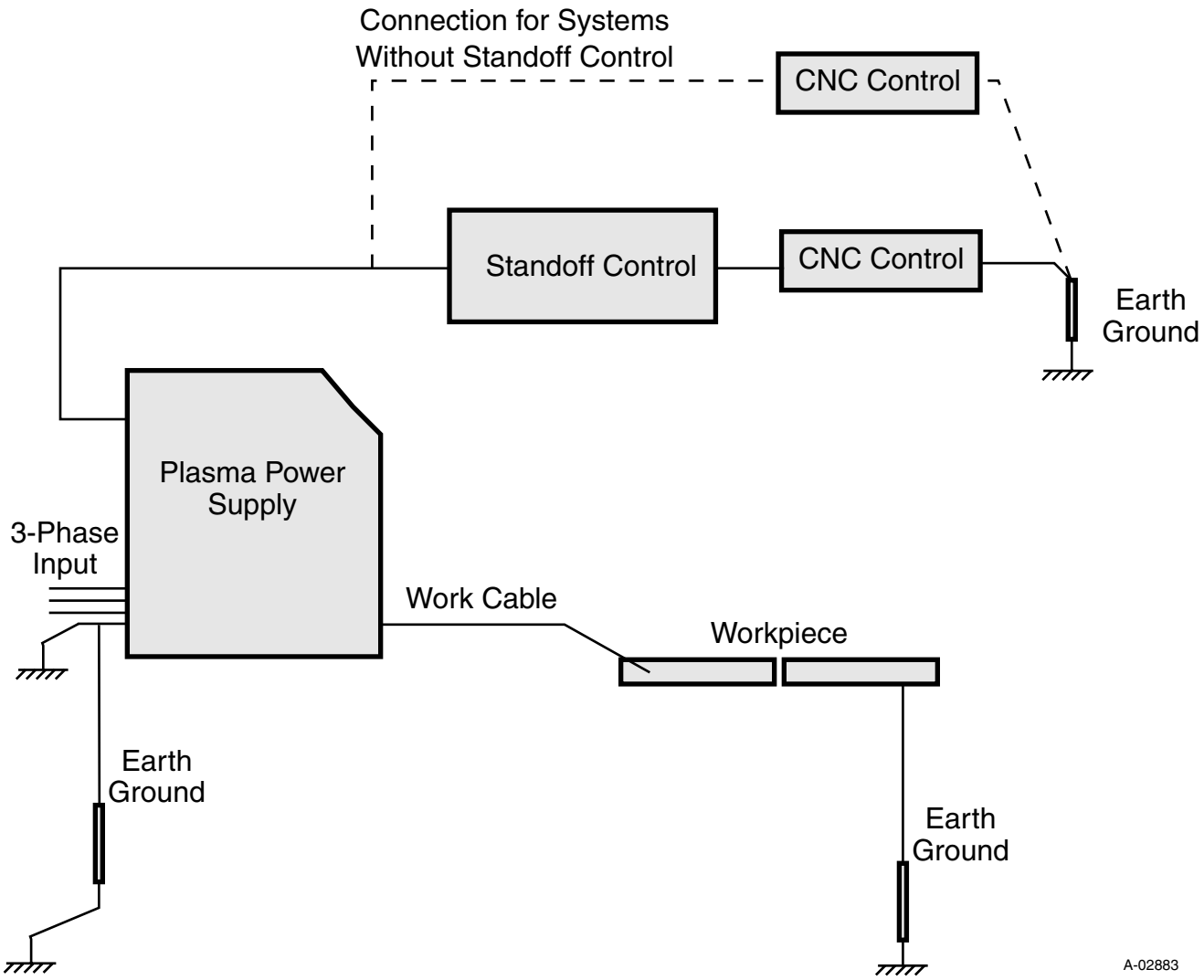
WARNING

DO NOT energize the Torch.

Drain distilled water and replace with Thermal Arc Coolant. Use Extra-Cool™ Coolant (Catalog #7-3580) or Ultra-Cool™ Coolant (Catalog #7-3581) for environments below +10° F (-12° C).

2. Check radiator fins, clean and comb out if necessary.
3. Repeat six month maintenance.

APPENDIX 14: TYPICAL MECHANIZED SYSTEM GROUNDING DIAGRAM

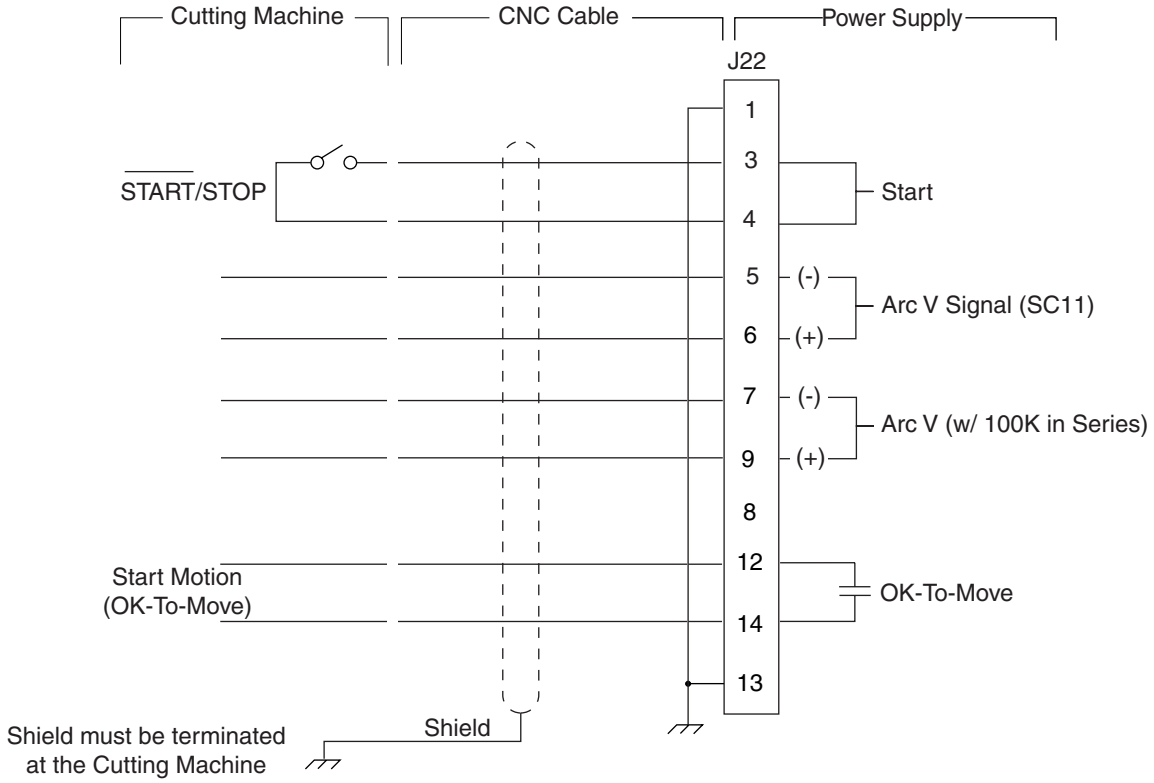


NOTE
Work Cable must connect direct to workpiece.
DO NOT connect Work Cable to earth ground and then to workpiece.

APPENDIX 15: POWER SUPPLY CNC INTERFACE DIAGRAM WITHOUT STANDOFF CONTROL

NOTE

Cable connections from Cutting Machine Controller (CNC) to Plasma Power Supply without any Standoff Control Accessory.



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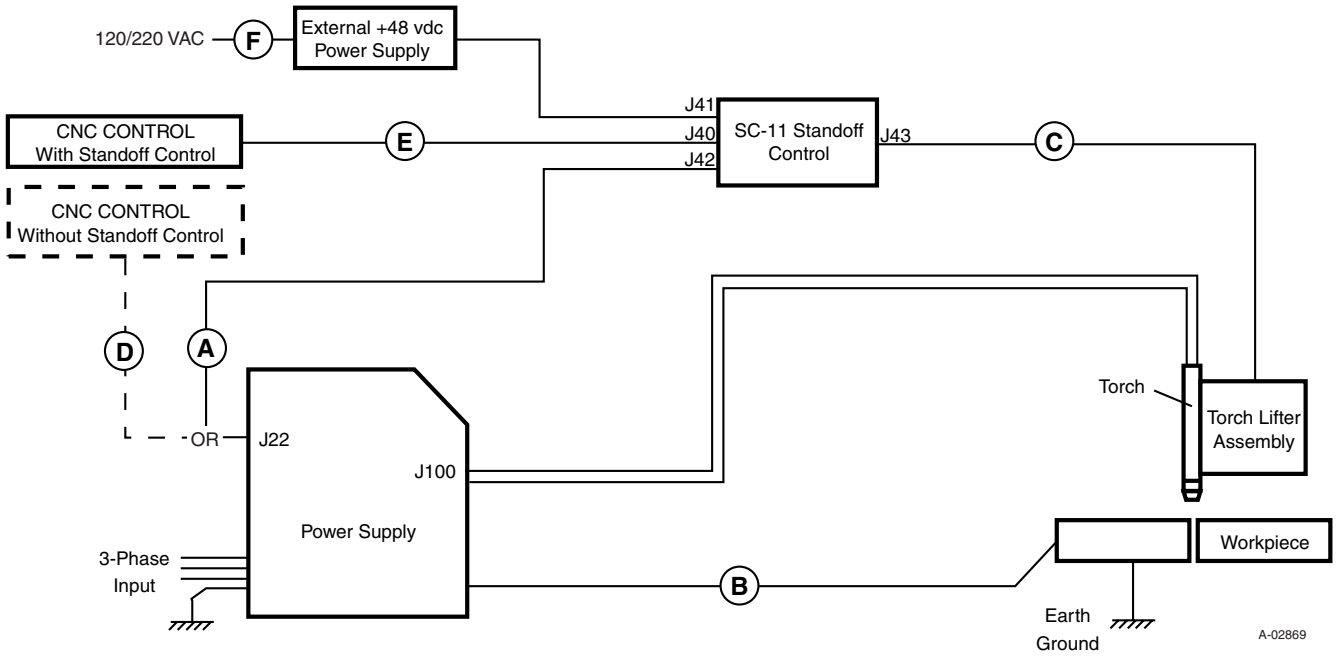
APPENDIX 16: TYPICAL MECHANIZED SYSTEM CABLE INTERCONNECTION DIAGRAM

NOTE

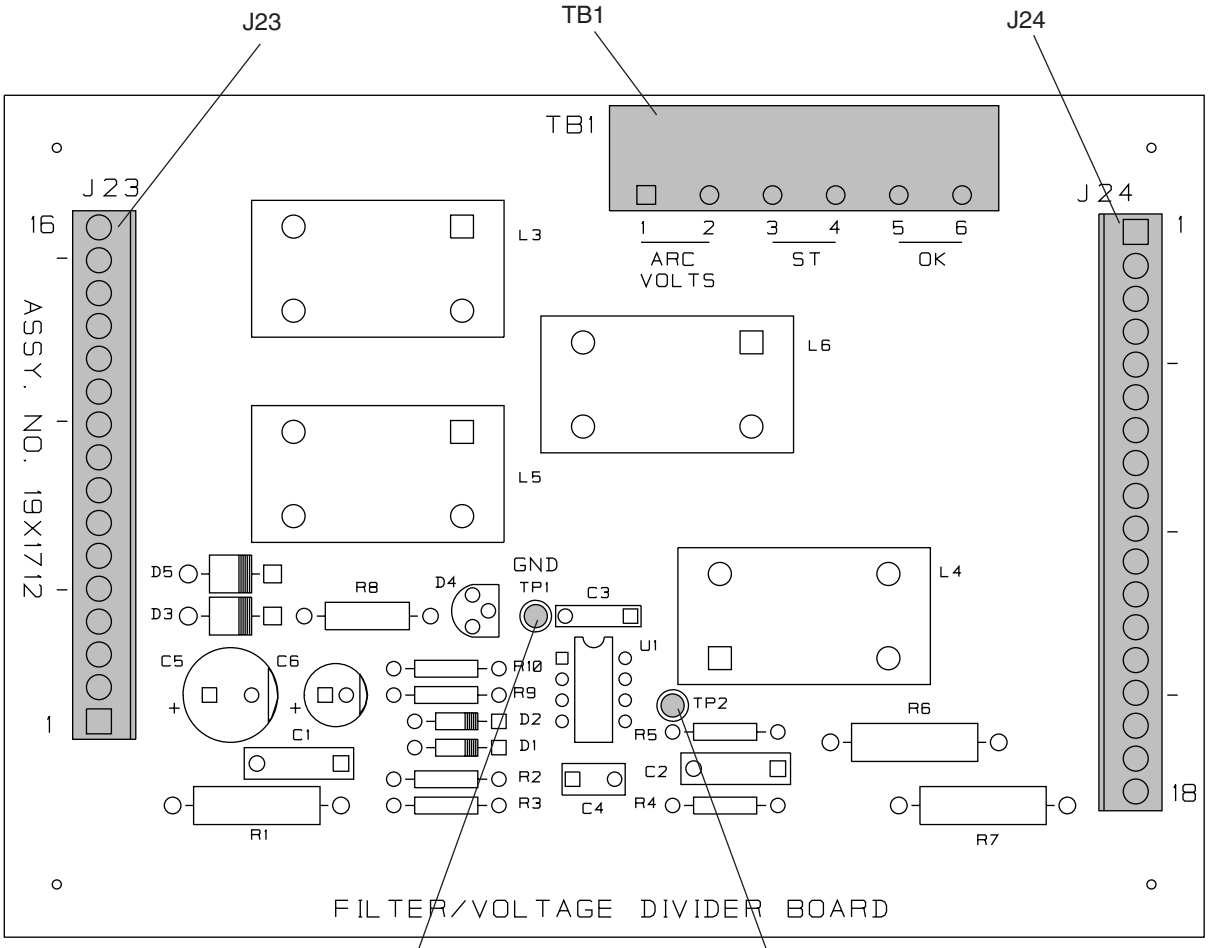
Refer to Appendix XVII for complete data on the Cables and Hoses.



APPENDIX 17: QUICK REFERENCE TO INTERCONNECTING CABLES AND HOSES

Identifier	Description	Catalog #
A	Remote Standoff Control Cable	
	50 ft (15.2 m)	9-9021
	75 ft (22.9 m)	9-9022
	100 ft (30.5 m)	9-9023
B	Work Cable, 22 ft (6.7 m)	9-7792
C	Lifter Motor Cable	
	10 ft (3.0 m)	9-4535
	15 ft (4.6 m)	9-4536
	20 ft (6.1 m)	9-4537
	25 ft (7.6 m)	9-4538
	40 ft (12.2 m)	9-7795
	50 ft (15.2 m)	9-4539
D	CNC Control Cable Without SC11	
	25 ft (7.6 m)	9-5651
	50 ft (15.2 m)	9-5652
E	CNC Control Cable With SC11	
	5 ft (1.5 m)	9-4483
	Other Lenghts Available	See SC11 Manual
F	48 vdc Power Supply Power Cord	9-9025

APPENDIX 18: FILTER/VOLTAGE DIVIDER PC BOARD LAYOUT



Filter/Voltage Divider PC Board A-02872

Filter/Voltage Divider PC Board Signals

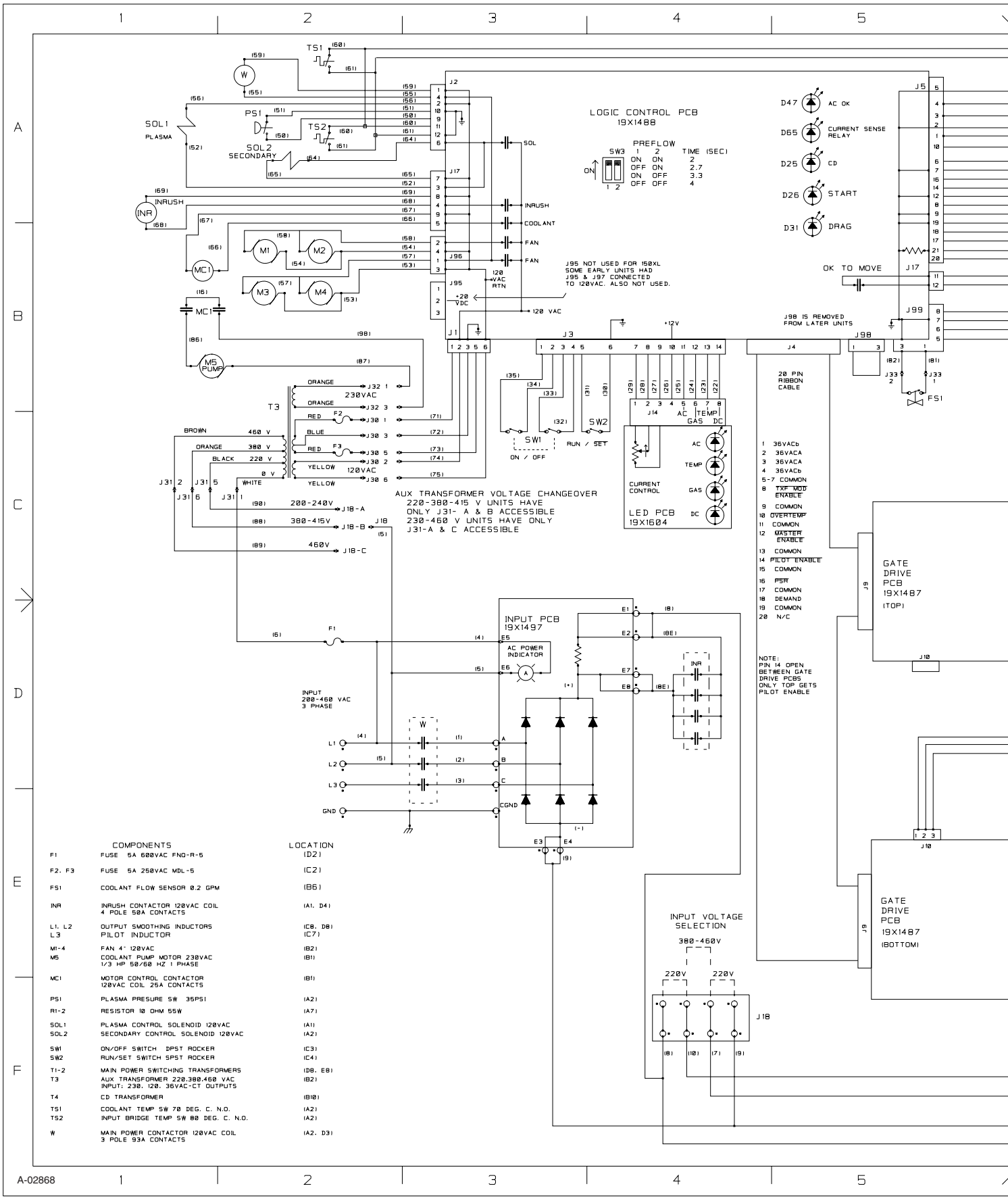
J23 Signals and Bias Power To and From Plasma Power Supply
J23-1 Negative Arc voltage input form plasma power supply
J23-2 Not Used
J23-3 Not Used
J23-4 Positive arc voltage (system common connection, work lead)
J23-5 Printed Circuit Board (PCB) power supply common
J23-6 Printed Circuit Board (PCB) power supply (24-36 VAC C.T. or 20-24 vdc)
J23-7 Printed Circuit Board (PCB) power supply (24-36 VAC C.T. or 20-24 vdc)
J23-8 Start signal from CNC
J23-9 Start signal return
J23-10 Not Used
J23-11 Circuit common connection for SC11 Standoff Control
J23-12 Spare
J23-13 Not Used
J23-14 OK-To-Move (relay contact in plasma power supply)
J23-15 Not Used
J23-16 OK-To-Move (relay contact in plasma power supply)

J24 Signals To and From CNC
J24-1 OK-To-Move to CNC (relay contact in plasma power supply)
J24-2 Not Used
J24-3 OK-To-Move to CNC (relay contact in plasma power supply)
J24-4 Not Used
J24-5 Spare
J24-6 Circuit common connection to SC-11 Standoff Control
J24-7 Not Used
J24-8 Start signal return from CNC
J24-9 Not Used
J24-10 Start signal from CNC
J24-11 Not Used
J24-12 Arc voltage signal to SC-11 Standoff Control
J24-13 Not Used
J24-14 Arc voltage signal rtn to SC-11 Standoff Control
J24-15 Not Used
J24-16 Arc voltage Positive with 100K series resistor
J24-17 Not Used
J24-18 Arc voltage Negative with 100K series resistor

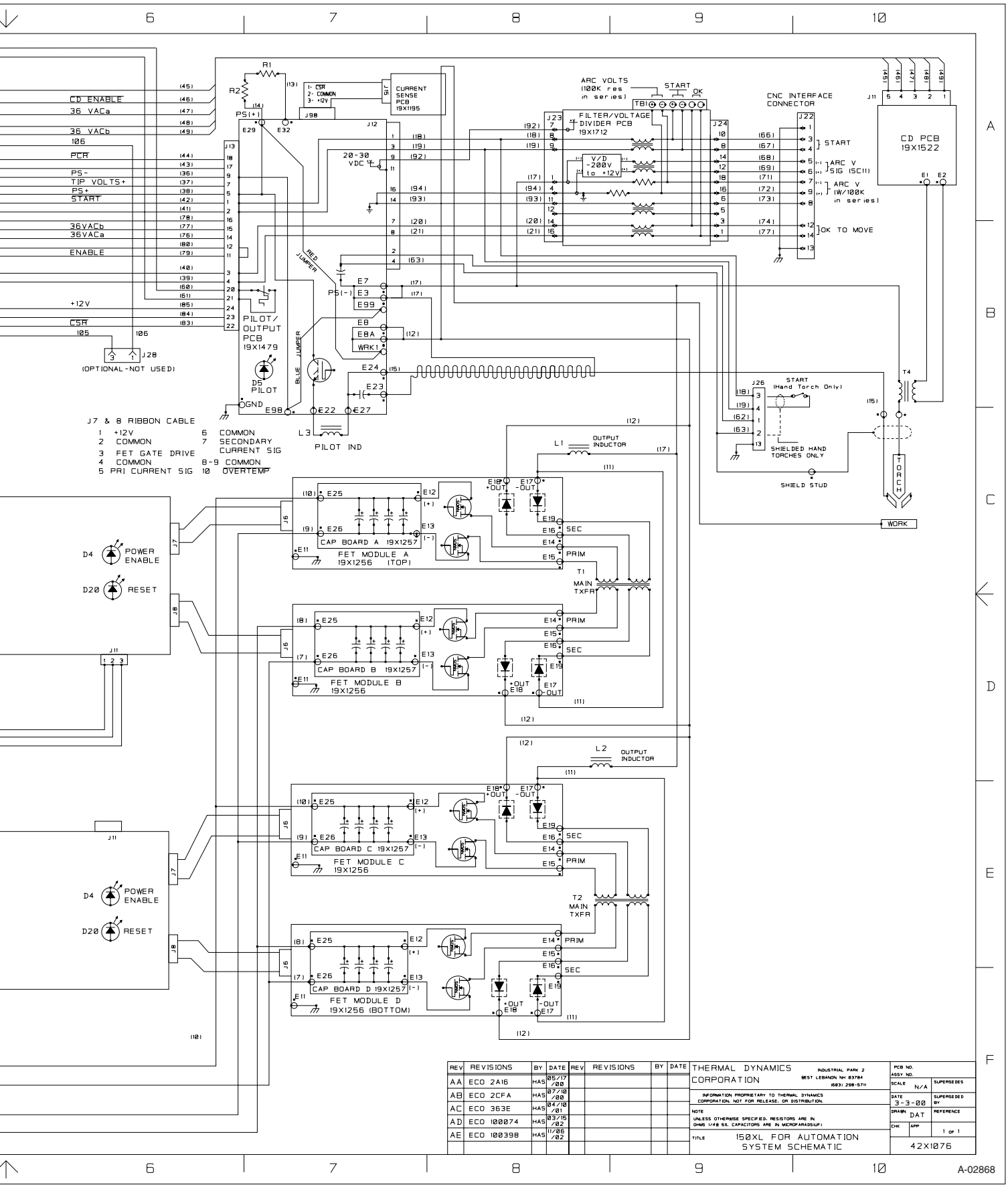
TB1-1 ARC Volts Positive w ith 100K series resistor (same as J24-16)
TB1-2 ARC Volts Negative with 100K series resistor (same as J24-18)
TB1-3 Start signal from CNC (same as J24-10)
TB1-4 Start signal return from CNC (same as J24-8)
TB1-5 OK-To-Move signal, relay contact from plasma power supply (same as J24-3)
TB1-6 OK-To-Move signal, relay contact from plasma power supply (same as J24-1)

TP1 GND
TP2 Output of SC-11 Standoff Control Voltage Divider Circuit (0 to –200 vdc arc volts = 0 to +12 vdc signal)

APPENDIX 19: SYSTEM SCHEMATIC for Units to Rev AH



	COMPONENTS	LOCATION
F1	FUSE 5A 600VAC FNQ-R-5	(D2)
F2, F3	FUSE 5A 250VAC MDL-5	(C2)
FS1	COOLANT FLOW SENSOR 0.2 GPM	(B6)
INR	INRUSH CONTACTOR 120VAC COIL 4 POLE 50A CONTACTS	(A1, D4)
L1, L2	OUTPUT SMOOTHING INDUCTORS	(C8, D8)
L3	PILOT INDUCTOR	(C7)
M1-4	FAN 4" 120VAC	(B2)
M5	COOLANT PUMP MOTOR 230VAC 1/3 HP 50/60 HZ 1 PHASE	(B1)
MC1	MOTOR CONTROL CONTACTOR 120VAC COIL 25A CONTACTS	(B1)
PS1	PLASMA PRESURE SW 35PSI	(A2)
R1-2	RESISTOR 10 OHM 55W	(A7)
SOL1	PLASMA CONTROL SOLENOID 120VAC	(A1)
SOL2	SECONDARY CONTROL SOLENOID 120VAC	(A2)
SW1	ON/OFF SWITCH DPST ROCKER	(C3)
SW2	RUN/SET SWITCH SPST ROCKER	(C4)
T1-2	MAIN POWER SWITCHING TRANSFORMERS	(D8, E8)
T3	AUX TRANSFORMER 220,380,460 VAC INPUT: 230, 120, 36VAC-CT OUTPUTS	(B2)
T4	CD TRANSFORMER	(B10)
TS1	COOLANT TEMP SW 70 DEG. C. N.O.	(A2)
TS2	INPUT BRIDGE TEMP SW 80 DEG. C. N.O.	(A2)
W	MAIN POWER CONTACTOR 120VAC COIL 3 POLE 93A CONTACTS	(A2, D3)



REV	REVISIONS	BY	DATE
AA	ECO 2A16	HAS	05/17 /00
AB	ECO 2CFA	HAS	07/10 /00
AC	ECO 363E	HAS	04/10 /01
AD	ECO 100074	HAS	03/15 /02
AE	ECO 100398	HAS	11/06 /02

THERMAL DYNAMICS CORPORATION
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NOTE
UNLESS OTHERWISE SPECIFIED, RESISTORS ARE IN OHMS 1/4W 5%. CAPACITORS ARE IN MICROFARADS(UF)

TITLE
150XL FOR AUTOMATION
SYSTEM SCHEMATIC

PCB NO.
ASSY NO.
SCALE N/A
SUPERSEDES
DATE 3-3-00
SUPERSEDED BY
DRAWN DAT
REFERENCE
CHK
APP
1 OF 1

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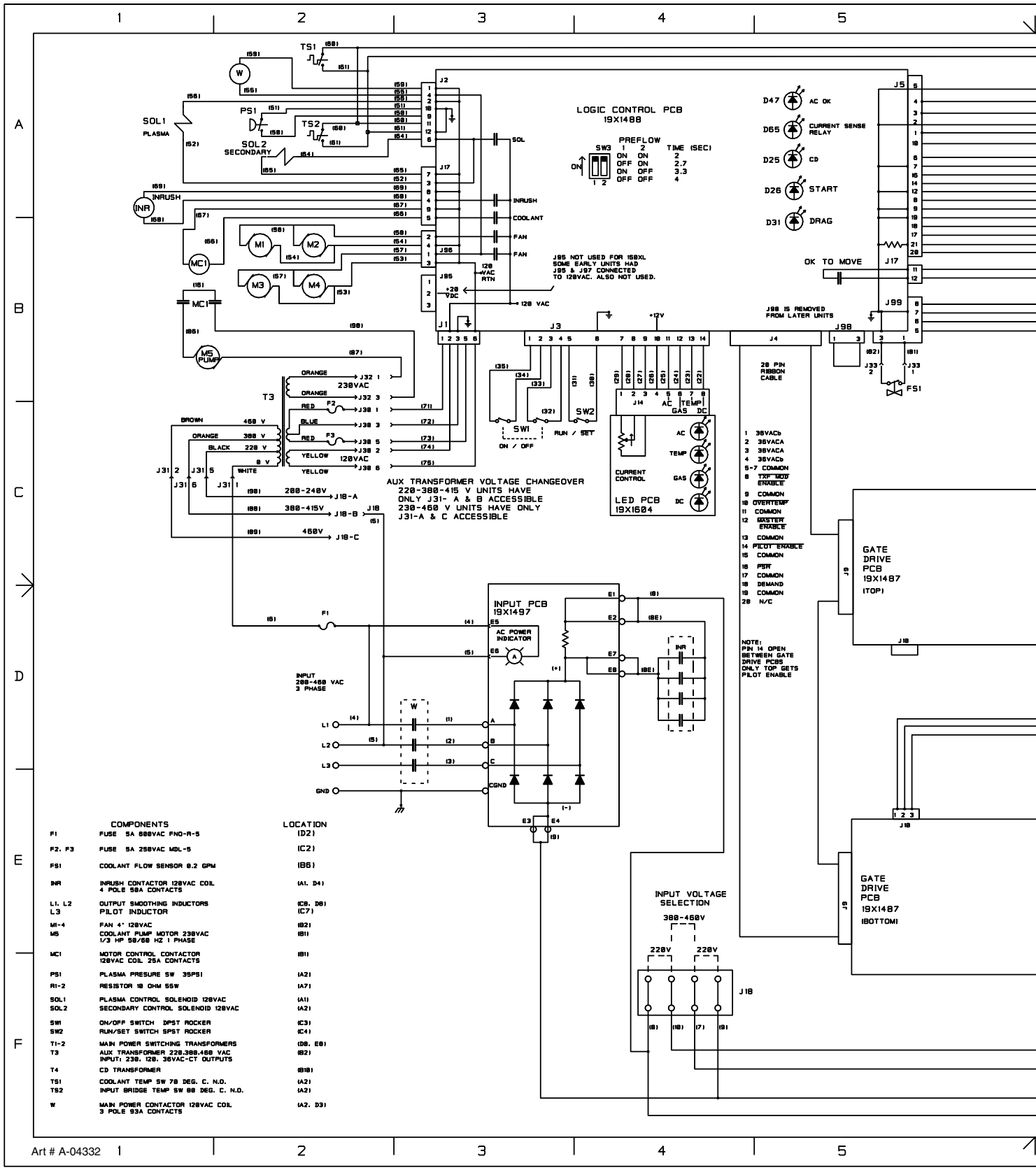
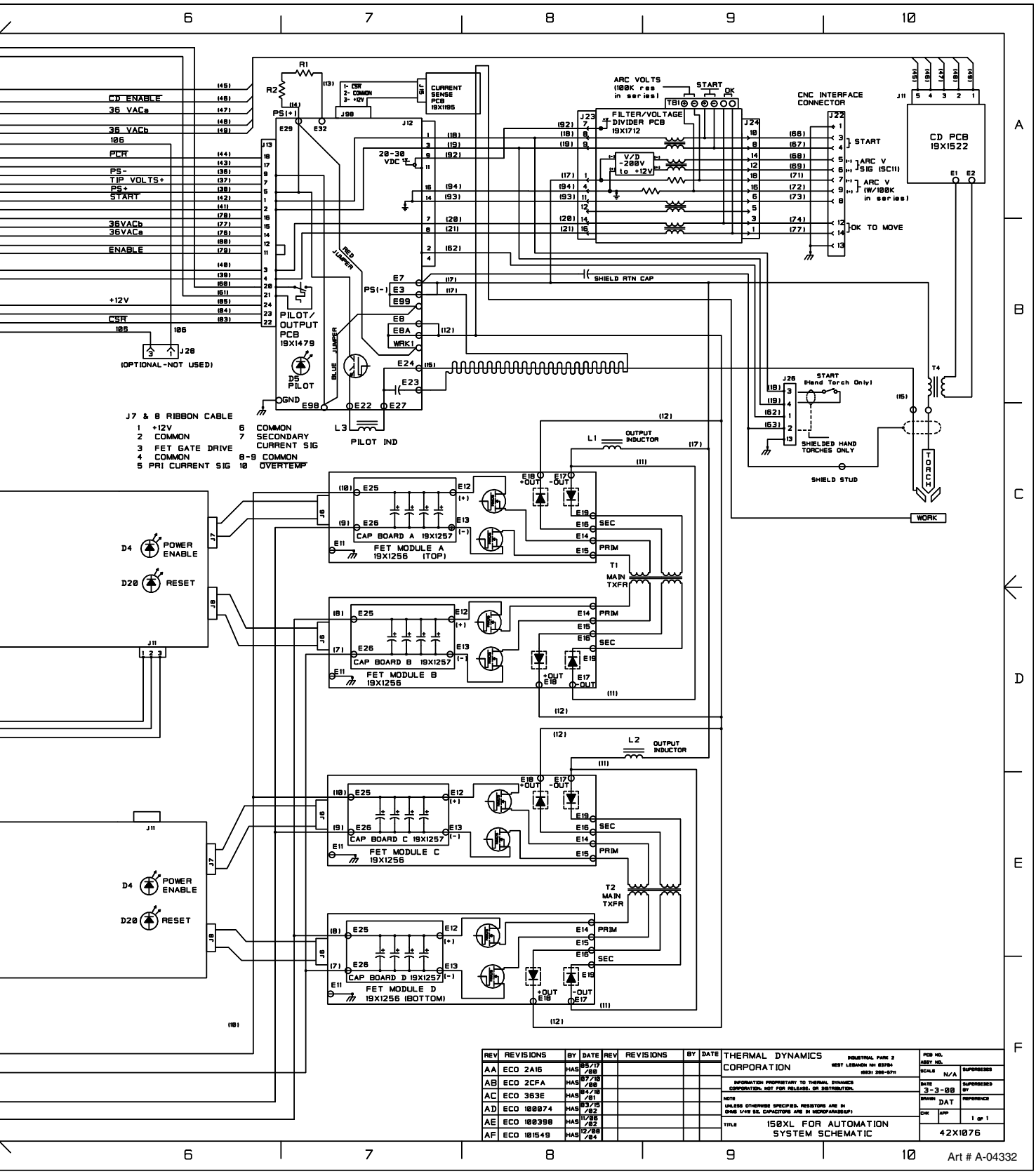
APPENDIX 20: SYSTEM SCHEMATIC for Units Rev AJ and Later





REV	REVISIONS	BY	DATE	REV	REVISIONS	BY	DATE
AA	ECO 2A16	HAS	05/17/88				
AB	ECO 2CFA	HAS	07/18/88				
AC	ECO 363E	HAS	04/18/91				
AD	ECO 100074	HAS	03/15/92				
AE	ECO 100398	HAS	11/06/92				
AF	ECO 101549	HAS	12/08/94				

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TITLE
150XL FOR AUTOMATION SYSTEM SCHEMATIC

PCB NO.
ASSY NO.
SCALE N/A
SUPERSEDES
DATE 3-3-00
SUPERSEDED BY
DRAWN DAT
REFERENCE
CHK
APP
1 of 1

42X1076

Art # A-04332